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Worksite Health Programs: Working Together to Advance Employee Health

The workplace is a common context within which health promotion, disease prevention, and injury prevention programs are conducted.[1,2] Health educators have been important contributors to the burgeoning area of worksite health promotion (WHP), with its traditional focus on individual behavior change of personal risk factors (e.g., smoking, lack of exercise, unhealthy diet). Recently, health educators and health behavior specialists are taking a more active role in occupational safety and health (OSH) programs that address the influence of physical, chemical, and psychosocial work exposures on employee health.

For WHP efforts, the worksite serves as a convenient venue for health programs, providing access to adult populations that might otherwise be hard to reach and providing organizational structures and norms that can facilitate successful individual behavior change (e.g., employer-provided incentives and the social influence of coworkers).[3] In contrast, OSH interventions attempt to reduce exposure to aspects of the worksite that are deleterious to employee health. OSH interventions may involve engineering strategies (e.g., making physical modifications to the worksite or work process), administrative strategies (e.g., management initiatives that modify the work process or environment), and individual behavior change strategies (e.g., educational training to increase personal protective equipment use).[4]

Perhaps because these two approaches to worksite health have different historical roots, disciplinary backgrounds, and intervention philosophies, they have tended to operate independently, even when present in the same workplace. In some cases, practitioners of these two approaches have viewed each other as competitors for resources rather than as partners working toward advancement in the field of employee health.[5] This theme issue is intended to foster a dialogue between those involved in designing, implementing, and evaluating WHP and OSH programs, thus creating an opportunity to explore potential points of synergy between these two approaches to worksite health. We believe that such a dialogue will help set an agenda for the advancement of the quality and scope of worksite health programs.

CROSS-CUTTING THEMES

Three important themes that cut across both WHP and OSH efforts emerged during the process of putting this theme issue together. These themes are introduced below and are discussed in more detail in upcoming articles in this issue.

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The Need for Broader, More Integrative Conceptual Frameworks

Within their traditional paradigms, both WHP and OSH programs have faced challenges in developing effective strategies for advancement in the field of employee health. For example, even carefully developed and meticulously implemented WHP programs have failed to bring about substantial, meaningful changes in employee health behaviors.[6,7] There have been similar disappointing findings in the OSH arena.[8,9] One inference from such results is that perhaps broader, more integrative conceptual frameworks are needed to guide the effective design and evaluation of worksite health programs.

Several examples of such frameworks are presented and discussed in this theme issue. Stokols et al.[10] present a social ecological perspective that incorporates three basic principles: (1) that physical and social environmental factors, along with personal factors, jointly contribute to healthy workplaces and healthy workers; (2) that nonoccupational and community settings influence employee well-being and worksite health programs; and (3) that health and illness outcomes should be studied from a multilevel and multidisciplinary perspective. DeJoy et al.[11] present a work-systems perspective that takes into account individual, job/task, and organizational factors. The authors then provide an example of how self-protective behaviors need to be analyzed within the context of specific job demands as well as broader organizational and environmental influences. Finally, Baker et al.[12] present a model, adapted from the stress literature, to illustrate opportunities for integrating the traditional concerns of both health promotion and occupational health and safety interventions. They emphasize the importance of (1) psychosocial resources (social support and control) in the workplace and (2) comprehensive and participatory approaches to worksite health. These models all share the characteristics of being multilevel (incorporating individual-, job-, and organizational-level factors), integrative (addressing both WHP and OSH concerns), and comprehensive (addressing physical, chemical, psychosocial, and behavioral threats to health). In addition, they all highlight the importance of context (e.g., nonoccupational factors, economic climate) when developing worksite health programs.

To date, these models have been underused by researchers and practitioners involved in worksite health programs. Several of the empirical articles in this issue illustrate how the basic tenets of these models might be tested. Sorensen et al.[13] used an ecological framework to guide the development and evaluation of a worksite cancer prevention program that addressed both occupational exposures to carcinogens and lifestyle risk factors for cancer. Crump et al.[14] investigated the extent to which the organizational context and the implementation process of health promotion programs were related to the rate and patterns of employee participation in the programs. Kidd et al.[15] addressed injury prevention among farmers, an occupational group for which the boundaries between work and nonwork are typically blurred. The authors' multilevel, contextual approach identified psychosocial, economic, and physical environment factors that influence farmers' safety decision-making processes.

The Application of Theory in Program Development

The conceptual frameworks described above provide an overarching view of the multitude of factors that are important to consider when developing worksite health

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programs. The effectiveness of these programs may be further enhanced by using theories that outline strategies for changing factors that contribute to deleterious effects on the health of the target population.[4] When WHP programs have been informed by theory, they have typically made use of social psychological or learning theories,[3] while OSH programs have tended to be based on engineering principles or industrial hygiene models.[4] Each approach may benefit from an increased knowledge and application of theories that are more typical of the other. For example, in this issue Sinclair et al.[16] used a theory of health behavior (protection motivation theory) to address a serious occupational safety problem—needlestick injuries among workers in the health care industry. The authors provide a detailed account of the challenging process of translating theoretical constructs into components of an OSH training program using video technology.

The Use of Multiple Assessment and Evaluation Methodologies

As comprehensive, context-inclusive, and systems-oriented frameworks are used more often to guide the development of worksite health programs, multifaceted data collection and data analysis methodologies are needed to adequately describe and assess worksite health problems and to evaluate the programs that are intended to address them.[10,17-18] In particular, worksite health practitioners and researchers may be called upon to use survey research methods; qualitative methods such as focus groups, field observations, and semistructured, in-depth interviews; physiological outcome measures such as biomarkers; and physical or chemical exposure measures more typical of industrial hygiene methods.

Several articles in this issue illustrate creative approaches to the collection and analysis of the data necessary for understanding the complex web of factors that affect employee health and worksite health programs. Crump et al.[14] used various data sources including case studies (developed from field observations and semistructured interviews with key informants) and employee surveys. Kidd et al.[15] used focus groups to collect qualitative data from farmers and their spouses and then systematically analyzed the data to develop a model of stress-related factors that lead to injury among farm families. Sinclair et al.[16] videotaped semistructured interviews with employees as part of the process of developing instructional materials.

CONCLUSION

From the many high-quality manuscripts that were submitted for consideration in this theme issue, we have learned that there are numerous worksite health practitioners and researchers interested in and actively working toward integrating the fields of worksite health promotion and occupational safety and health. Whether spurred forward by the increasing application of social ecological principles to worksite health programs, or by the less than satisfactory performance of existing health programs and the accompanying recognition for the need for more comprehensive approaches, or by a desire to concentrate dwindling resources in collaborative efforts, the time seems ripe for developing interventions that are integrative and mutually beneficial to both worksite health promotion and occupational safety and health programs.

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The Ecology of Work and Health: Research and Policy Directions for the Promotion of Employee Health

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This article identifies new research and policy directions for the field of worksite health in the context of the changing American workplace. These directions are viewed from an ecological perspective on worksite health and are organized around three major themes: (1) the joint influence of physical and social environmental factors on occupational health, (2) the effects of nonoccupational settings (e.g., households, the health care system) on employee well-being and the implications of recent changes in these settings for worksite health programs, and (3) methodological issues in the design and evaluation of worksite health programs. Developments in these areas suggest that the field of worksite health may be undergoing a fundamental paradigm shift away from individually oriented wellness programs (provided at the worksite and aimed primarily at changing employees' health behavior) and toward broader formulations emphasizing the joint impact of the physical and social environment at work, job-person fit, and work policies on employee well-being.

This article applies a social ecological perspective to the discussion of current limitations, challenges, and future directions for worksite health programs and research. The field of worksite health has grown substantially over the past 15 years with the development of sophisticated programs that are both health conscious and cost-effective.[1-6] At the same time, however, the research literature on worksite health reflects certain limitations and challenges that remain to be addressed. The first portion of the article outlines the social ecological perspective as a guiding framework from which to develop more comprehensive and effective strategies for promoting employee health. Next, limitations and challenges reflected in earlier worksite health programs and research are discussed. The remaining sections of the article examine research questions and directions for the field of worksite health in relation to the proposed social ecological framework.

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The Social Ecology of Worksite Health: Theoretical Principles

This discussion of worksite health is guided by a social ecological perspective.[7-11] The term *ecology* pertains broadly to the relationships between organisms and their environments.[12] The field of social ecology focuses on the interactions between humans and their environments and places greater emphasis on the social, institutional, and cultural contexts of people-environment relations than did earlier versions of bioecology.[13,14,15] Social ecology offers a set of theoretical principles for understanding the relationships between diverse personal and environmental factors in human health and illness. Three of these principles are outlined below.

First, an individual's or group's health status is assumed to be influenced by multiple environmental and personal factors. Environmental factors relevant to health subsume several features of one's physical and sociocultural surroundings. Personal variables related to health status also encompass a variety of factors such as biogenetic heritage, psychological dispositions, and patterns of behavior. Rather than focusing exclusively on environmental or personal factors, social ecological models emphasize the importance of considering the joint influence of these factors on employee well-being. Moreover, from a social ecological perspective, worksites are viewed as complex systems, comprising multiple social and physical environmental conditions, which jointly influence physical, mental, and social well-being.[16,17] Thus the health-promotive capacity of a work environment reflects the cumulative influence of multiple environmental conditions on several facets of employee well-being—all of which should be considered in the design and implementation of worksite health promotion programs.

Second, social ecological models of worksite health emphasize the linkages that exist between the workplace and employees' other life settings, such as their residential environments, their modes of commuting to and from work, and the community health care system that exists beyond the workplace. Employee health can be influenced by circumstances within any and all of these life domains. Accordingly, social ecological approaches to worksite health consider employee well-being within the context of both work and nonwork settings. Moreover, they highlight the importance of developing comprehensive programs that integrate the wellness resources offered to employees at the worksite with the health care and medical services available in the broader community.

Third, social ecological models emphasize a multilevel and multidisciplinary perspective on health and illness. Just as environmental influences on health span multiple levels of one's surroundings (e.g., from the physical and social conditions existing within one's immediate worksite to community-wide occupational safety regulations), the manifestations of health and illness also can be examined at several levels of analysis (e.g., physiological, psychological, interpersonal, organizational, institutional, and community). The fact that an individual's or group's health status is influenced by multiple circumstances found at different levels of the environment suggests that worksite health can best be understood from a multidisciplinary perspective—one that integrates knowledge and research methods drawn from several different fields (e.g., occupational safety and health, health education, medicine, law, facilities planning and management)—rather than relying exclusively on unidisciplinary theories and methods.

Limitations and Challenges Reflected in Earlier Worksite Health Programs and Research

The social ecological perspective highlights some important limitations of earlier worksite health programs and research. First, U.S. worksite health programs generally have emphasized behavioral change efforts to modify individuals' lifestyles, while often neglecting opportunities to combine person-focused interventions with environmental enhancement strategies.[7,18,19] Worksite health programs outside the United States (e.g., in Scandinavia), however, have been more attentive to environmental factors.[8] Second, behavioral interventions to promote employee well-being have focused, for the most part, on changing personal health practices rather than the actions of corporate and public decision makers who influence others' well-being.[20,21] Third, worksite health programs have emphasized the reduction of physical and mental health problems, while paying less attention to opportunities for cultivating highly positive states of well-being (e.g., enhanced levels of creativity, group cohesion, and organizational effectiveness).[22,23,24]

Fourth, the methodological shortcomings evident in many earlier studies pose a variety of challenges for future research. These challenges include the design and implementation of prospective field-experimental studies to evaluate the effectiveness of worksite health promotion and occupational health and safety programs;[25,26] the development of improved measures for gauging the health, productivity, and economic outcomes of these programs;[27] and the customization of worksite health programs to address the special needs of small businesses as well as large corporations, part-time or unemployed workers, and diverse age, ethnic, and cultural groups within the workforce.[28,29,30]

Finally, the emergence of new models for managing the delivery of medical and preventive services is dramatically altering the structure of worksite health programs. Large employers are shifting the burden of providing health promotion and disease prevention services to outside vendors by incorporating such services into the bid specifications given to competing providers. In the future, large companies and purchasing cooperatives may not actually deliver health promotion and disease prevention services at the worksite, but instead function as well-informed purchasers of such services from competing health plans, insurance carriers, community hospitals, and other sources. As new models of managed care evolve, they will likely forge closer collaboration between payers and providers in the delivery of health promotion, disease prevention, and medical services for employees.[31]

Opportunities for Future Research and Practice in the Field of Worksite Health

The core principles of social ecology outlined earlier suggest some important issues that remain to be addressed in future worksite health programs and research. This section offers a brief overview of these issues. The following section, focusing on research questions and directions, examines these issues in greater detail.

First, the systemic organization of work settings posited by social ecological analyses of employee health suggests that certain high-impact "leverage points" for health promotion can be identified within work organizations and should be targeted by worksite health interventions.[21]

Programs that directly influence the decisions and behavior of these pivotal roles and individuals within organizations may have a greater capacity to enhance worksite health than those that rely exclusively on efforts to modify individual workers' health behavior.

Moreover, the systemic view of work organizations suggests that levels of productivity and organizational effectiveness may be closely related to employee health, creativity, and morale, and that efforts to gauge the health and cost benefits of worksite interventions should examine these outcomes as interrelated criteria rather than as separate and isolated indicators of program success.[4,32,33] Previous studies have been unable to ascertain the relationships among these phenomena due to limitations in the measurement of employee creativity, productivity, and organizational effectiveness.[27,33] In the future, methodological improvements may permit a better understanding of the circumstances under which employee health status is positively, negatively, or negligibly related to levels of productivity or organizational effectiveness. We are not suggesting that a positive association between employee wellness, productivity, and organizational effectiveness is a prerequisite for investing in worksite health programs. Clearly, the justifications for and benefits of such programs are multifaceted (e.g., moral and legal grounds for ensuring healthful working conditions; improved quality of worklife; employee recruitment and retention), and noneconomic considerations often outweigh the financial investment required to implement and sustain them. Nonetheless, a better understanding of the relationships between noneconomic benefits of worksite health programs and those pertaining to productivity and organizational effectiveness would be desirable, as it would provide a basis for improving the health benefits and cost-effectiveness of such programs.

Second, the assumption that work settings are situated within a broader structure of community settings (including residential and transportation environments, the health care system, regulatory and public policy contexts) suggests some important issues for future research,[7,19,34,35] including (1) the joint influence of workplaces, family settings, and commuting conditions on employee health and productivity; (2) the influence of community economic conditions and trends toward downsizing, part-time employment, and unemployment on personal, family, and organizational well-being; (3) the relationship between community norms for corporate behavior (e.g., providing on-site day care, a smoke-free workplace, and flexible scheduling of work hours) on the healthfulness of work environments; (4) the implications of demographic shifts in the age, ethnic, and gender composition of the workforce for worksite health promotion; (5) the spillover of community-wide problems, such as neighborhood and workplace violence (especially toward women) and the AIDS epidemic, to the workplace; (6) the impacts of legal interventions (e.g., the Americans With Disabilities Act (ADA); California's Worksite Injury and Illness Prevention Law (SB198); legal reforms regarding workers' compensation for occupational illness and injury) on employees' health, productivity, and medical insurance claims; and (7) the influence of technological innovations within the broader community (e.g., electronic mail, fax machines, mobile phones, and telecommuting) on the development and delivery of innovative worksite health programs (e.g., "electronic housecalls," telephone care, and computer-assisted screening for medical risk factors).[4,36-39]

Third, the assumption that multidisciplinary perspectives and diverse methodologies are essential for the design, implementation, and evaluation of effective worksite health programs points toward some important directions for future research. Too often, evaluations of worksite health interventions focus narrowly on a limited subset of potentially relevant criteria (e.g., biometric response indices or toxicant exposure levels) for judging program success. Future studies of worksite health programs should encompass a broader

array of measures and tools, including health assessments, questionnaires, behavioral observations and activity logs, and environmental recordings, and be subjected to both epidemiologic and financial analyses.

Moreover, the social ecological perspective highlights the value of conducting prospective evaluations of intervention outcomes and effectiveness. For example, broad-gauged program evaluations might incorporate pre- and postintervention assessments of individuals' health practices and emotional well-being; levels of cooperation and conflict within organizations; personal or group exposure to physical environmental hazards; archival data on illness and mortality rates among different occupational and demographic groups; and direct or proxy measures of employee health costs, productivity, and organizational effectiveness. In addition to summative evaluations of program outcomes, formative evaluations of the effectiveness with which intervention components are implemented should be incorporated to assess overall program results.[40,41]

The next section outlines high-priority research questions and directions and is organized around the three social ecological principles noted above: (1) physical and social environmental factors that jointly contribute to the healthfulness of the workplace, (2) the influence of nonoccupational and community settings on employee well-being and worksite health programs; and (3) methodological approaches to the design of worksite interventions and multimethod strategies for gauging the health and cost-effectiveness of these programs.

RESEARCH QUESTIONS AND DIRECTIONS FOR THE FIELD OF WORKSITE HEALTH

Physical and Social Environmental Factors in Occupational Health

Earlier worksite health programs have emphasized behavioral change and lifestyle modification programs aimed at individual employees, while giving less attention to interventions involving the restructuring and enhancement of work environments. Future worksite interventions and evaluation studies should pay more attention to the health-promotive as well as the health-impairing qualities of the physical and social environment at work.

The Impacts of Workplace Hazards, Physical Environmental Stressors, and Facility Design on Employee Health and Productivity

Several physical conditions of workplaces have been found to influence employee health, productivity, and morale. These conditions include poor indoor air quality, or the "sick building syndrome";[42,43] poor ergonomic design of office furnishings and computer terminals;[44,45,46] involuntary exposure to tobacco smoke,[47] lead, and asbestos;[48-51] and environmental demands such as noise, distraction, and privacy infringements often associated with inadequate spatial arrangements and facility designs.[52,53]

To date, very few prospective studies have been conducted to evaluate the health and productivity impacts of environmental changes aimed at alleviating these problems. There is a need for new worksite health studies that evaluate the separate and joint effects of active and passive interventions to promote employee well-being.[54] Active interventions

include a variety of behavioral change and lifestyle modification programs (e.g., regular use of protective equipment by employees working with hazardous materials; proper lifting techniques; smoking cessation, exercise, and dietary interventions) that require voluntary and sustained effort by individuals as a prerequisite for achieving the desired health benefits. Passive interventions include various environmental interventions (e.g., removal of cigarette vending machines from factories and office buildings, use of nontoxic furnishings and equipment, installation of high-quality air conditioning and purification systems, environmental supports for privacy regulation) that require little or no effort on the part of individuals.[55,56,57]

In recent years, innovative worksite health programs incorporating multicomponent versus single-factor interventions have been implemented by several large corporations (e.g., AT&T, Johnson & Johnson, IBM, Steelcase, American Airlines).[4] Future evaluations of comprehensive worksite programs that include both active and passive interventions for promoting employee health will likely require a multidisciplinary team of individuals who are familiar with diverse theoretical and methodological perspectives (e.g., occupational safety, health education, disease prevention, employee assistance programs, facilities planning and management), and are capable of integrating these perspectives in the design of worksite health interventions and policies.[7,51,55,56,58]

A trend toward greater integration of occupational medicine concerns and worksite wellness programming is evidenced by recent efforts in several states (e.g., California, Florida, Oregon, Minnesota) to curb rapidly rising rates of workers' disability claims. In California, for example, legislation was enacted in 1993 to counter the unchecked rise in workers' compensation claims for both physical and psychological (stress-related) disabilities. That legislation established a new state-regulated managed care system for occupational injuries and illness.[59] An important goal of this mandate, in conjunction with CAL-OSHA's regulations relating to worksite injury and illness prevention,[60,61] is to combine environmental and behavioral interventions for preventing employee injuries with disability management and clinical services for injured workers.

Social Structural Interventions to Promote Employee Health and Productivity

Numerous studies have documented the significant correlations between socially supportive work groups, positive organizational climates, and employee well-being.[23,62-67] Yet few studies have prospectively evaluated the health and productivity gains attributable to social structural interventions at the worksite.[68] For example, the health effects of implementing participatory management strategies, quality circles, and conflict resolution procedures remain to be evaluated in future research.[69-72]

Moreover, the role of organizational climates in moderating employees' responses to physical environmental stressors (e.g., high levels of ambient noise, faulty ergonomics, and poor environmental design), and in encouraging their maintenance of good health practices (e.g., physical fitness activities, avoidance of smoking, excessive alcohol consumption, and high-fat diets) has not been investigated in prior research.[21] Finally, the joint contributions of organizational and facility design interventions in fostering teamwork and collaboration among coworkers (e.g., office layouts that promote informal communication and effective privacy regulation) remain to be explored in future studies.[32,73,74,75]

Worksite Interventions to Enhance Creativity and Innovation

Worksite health promotion programs generally have placed greater emphasis on the avoidance of physical and mental health problems, and the reduction of risk factors for major illnesses, than on the promotion of high levels of performance, organizational commitment, perceived quality of work life, and emotional well-being. For example, little is known about the physical and social environmental conditions (e.g., supportive social climates, changes in the physical design and decor of the workplace, movement between alternative work environments) that may enhance creativity and productivity in occupational settings.

Measures of employee creativity and organizational innovation are usually omitted from studies of worksite health promotion. Future research should incorporate multiple measures of employees' physical health status, the quality of their social relations with coworkers, and indices of mental health and work performance, including levels of creativity, perceived quality of work life, and job satisfaction.[16,22,24,76,77] The measurement of employee creativity and organizational innovation poses both conceptual and methodological complexities that remain to be addressed in future research. First, criteria for identifying creative products or processes in the workplace vary considerably across different industries and job categories. For instance, creativity may be manifested quite differently among factory workers, data entry clerks, and corporate managers. Also, workplace innovations often emerge gradually and may be difficult to detect through short-term studies. These considerations suggest that careful attention must be given to the selection of measurement strategies and research designs if employee creativity and organizational innovation are to be effectively evaluated as potential outcomes of worksite health programs.

Targeting High-Impact Organizational "Leverage Points" in Worksite Health Promotion Programs

Certain key roles, behaviors, and environmental conditions within work settings exert a disproportionate influence on employee well-being. For example, plant supervisors are entrusted with maintaining safe work practices and operable emergency equipment in factory settings. Similarly, facility managers can influence the health of office workers by ensuring that they are provided with ergonomically adjustable chairs and work surfaces. And corporate nutritionists can decide to include only heart-healthy selections on their cafeteria menus. These and other occupational roles, behaviors, and environmental factors can be targeted as high-impact "leverage points" for enhancing worksite health.[21] Previous research on behavioral change strategies of health promotion have focused primarily on modifying personal health behavior (actions taken by individuals that affect their own well-being), rather than influencing organizational and community decision makers whose behavior affects the health of many other people.[54,78] Yet corporations are increasingly relying on intermediaries to ensure the health and safety of their employees.

Within large companies, for example, medical benefits are often administered by health maintenance organizations whose case managers decide whether to approve payment for mental health counseling visits, diagnostic tests, medical treatment, and rehabilitative therapy for particular employees. Also, legal initiatives to protect the healthfulness of

occupational environments generally require companies to designate a coordinator who is officially responsible for maintaining organizational compliance with the legislative requirements.[60,79,80] The delegation of responsibility for providing employee medical and preventive services (to intermediaries and third parties) will substantially increase the extent to which a small number of decision makers can either enhance or impair the health of large numbers of workers. Future health promotion studies and intervention programs should identify high-impact roles in corporate settings that have the capacity to influence the health and safety of numerous employees, design and evaluate train-the-trainer programs aimed at facilitating the health-promotive activities of decision makers in both small businesses and large corporations, and reduce organizational barriers (e.g., bureaucratic rigidities, overload of work demands) that can undermine the effectiveness of worksite health coordinators.

Influence of Nonoccupational Settings on Employee Well-Being and Worksite Health Promotion

This section addresses the functional links and reciprocal influences among work environments, residential and family settings, the health care system, and the regulatory and public policy contexts that impinge on worker health and safety. The rapidity and pervasive scope of technological, sociodemographic, and legislative changes over the past decade, and the implications of these societal events for worksite health programs, raise several important questions for future research.

Health Consequences of Rapid Changes in Occupational and Family Roles

Over the past 10 years, the composition of the U.S. workforce has changed substantially. During this period, increasing numbers of women and older workers have joined the labor force. The proportions of single-parent and dual-career families in the United States also have grown dramatically during this period. And, in certain regions of the country such as the Southwest, the cultural and ethnic diversity of the workforce also has increased.

One consequence of these demographic shifts is that U.S. workers must now cope with more stringent job pressures and constraints on their discretionary or leisure time. These work pressures and time constraints are especially pronounced among dual-career and single parents who must balance child care and occupational roles.[81,82,83] The potentially adverse effects of job strain on health may be particularly severe among single mothers.[84] Also, the pressures of dual-career and single parenting, physical and social constraints associated with aging, and minority ethnic status may render employees more vulnerable to work-related stress and health problems.

Future research should examine the empirical links between marital and parental status, family structure (e.g., number and ages of children, single- vs. dual-career status), and employee well-being. Earlier studies suggest that certain demographic groups in the workforce may be more sensitive to the physical and social demands of their jobs and to stress-related disorders.[81-85] In future research, employee health programs that are tailored to the unique needs of different groups (e.g., worksite child care services, flexible work schedules, ergonomic equipment to accommodate the requirements of older workers, and

health support programs for retirees)[86] should be designed, implemented, and evaluated for their health benefits and cost-effectiveness.

Health Consequences of the Commute Between Home and Work

Commuting between home and work is an important extension of the occupational environment. Rush-hour commuting has been identified as a source of psychological stress, elevated blood pressure, performance decrements, and increased illness symptoms among full-time workers.[87-90] A recent study found that the negative emotional states associated with rush-hour commuting carry over from occupational and transit settings to the home environment.[91] Furthermore, working mothers whose commutes to and from work include stops at their children's day care centers are especially vulnerable to commuting stress.[92]

These findings pose a key question for future research: Are company-sponsored ridesharing programs effective in improving workers' health, job performance, and morale? A growing number of companies are investing in vanpool and carpool programs for their employees, yet little is known about the impacts of these programs on employee health and performance at work. Future studies should evaluate the health and performance effects of employees' participation in corporate ridesharing programs, as compared with alternative commuting modes (e.g., solo automobile driving, telecommuting from home or other remote locations via electronic links to a central worksite).[93,94]

Health Impacts of Economic Recessions, Corporate Restructuring, and Unemployment

Economic recessions of the 1980s and 1990s raised the unemployment rate among U.S. workers and prompted major changes in corporate structure, including downsizing, rightsizing, and a shift from full-time to part-time employment in many sectors of the economy. These structural changes in work organizations have eroded the quality and scope of health insurance coverage and other employee benefits, especially among workers who have shifted from permanent to temporary or contract status and, generally, have placed greater demands on employees who are often asked to do more work for less compensation. There is also concern about workers who may remain employed but in positions they dislike or perceive to be below their level of competence. Merely surviving in a job may have deleterious health consequences under such conditions.[24] Moreover, employees are frequently confronted by changes in the physical arrangement and location of their worksite,[95,96] and the threat of job displacement through workplace automation.[97] Not surprisingly, then, workers' concerns about job security and the challenges of midlife career changes have increased in recent years.[98]

According to the demand/control model of occupational stress,[99,100] highly demanding jobs that offer few opportunities to workers for exercising "decision latitude" and personal control create the greatest psychological burdens or job strain and increased vulnerability to stress-related diseases. These occupational health risks can be expected to become more severe during times of rapid economic, organizational, and technological change. Moreover, the higher levels of stress and interpersonal strain brought about by corporate

restructuring and impending job loss may increase the incidence of employee burnout and workplace violence.[101,102,103]

Societal changes that have transformed the American workplace in recent years pose several challenges for worksite health programs. First, high-strain jobs need to be identified and redesigned to achieve a better balance between workers' psychological needs for control, the day-to-day demands of their work, and the performance criteria of their employers.[97,100,104,105] Second, employee assistance programs (EAPs) should develop strategies for providing increased counseling and social support among those employees most concerned about job security, relocation, and outplacement.[106,107] Finally, corporate programs designed to assist former employees who have lost their jobs, as they make the transition to new careers, need to be developed and evaluated for their effectiveness in preventing the health problems that are often associated with unemployment.[108-112]

Integrating Worksite Health Programs With Community-Based Health Care Services

The rapid escalation of U.S. health care costs has provoked national debate about the feasibility and effectiveness of alternative cost-containment strategies. Managed competition, global budgets, and the rationing of medical care are among the structural reforms that have been proposed.[4,113] Regardless of the particular reforms enacted during the next few years, it is clear that health promotion, disease prevention, and injury prevention programs will play an increasingly important role in corporate, community, and providers' efforts to reduce the demand for, and costs of, medical care.[31,114,115]

The impending reform of the health care system has stimulated the development of several innovative worksite health programs in recent years.[3,4] Examples of these programs include the combined use of blood pressure monitoring, follow-up counseling, and referral to community physicians to reduce hypertension among employees at manufacturing plants;[116,117] and the establishment of employee advisory boards in blue-collar worksites to enhance social support, environmental quality, and workers' participation in the planning and evaluation of worksite health programs;[66,67,71] the Stanford Corporate Health Program, in which university researchers, corporate executives, insurance carriers, and physicians collaborate in evaluating the health and cost outcomes of employee wellness and medical programs;[4] the Stanford Coronary Risk Intervention Program (SCRIP), in which cardiac patients at the Stanford University School of Medicine are offered multicomponent treatment programs that combine lifestyle change regimens with pharmacological interventions delivered by telephone using computer algorithms;[36] and a variety of medical surveillance and risk-appraisal programs that use mail, telephone contacts, and "electronic house calls" to deliver primary care services to prospective or recovering patients at their homes and worksites.[24,37,38,39,118,119]

These innovative programs provide a solid foundation for developing even more comprehensive approaches to worksite and community health promotion in future research. For example, the collaboration among university researchers, corporate managers, insurance carriers, and primary care physicians, reflected in the SCRIP and Corporate Health Programs at the Stanford University School of Medicine, could be expanded to include other sectors of the community (e.g., public health officials, environmental health specialists, urban planners, television and news media) in an effort to establish comprehensive "healthy cities" programs.[120-124]

Also, telecommunications technologies such as electronic mail, telefax, video, and computer interactive systems could be used in corporate settings to encourage employee participation in worksite health promotion programs. Such systems could be used for the delivery of educational programs on AIDS prevention,[125,126] smoking cessation, environmental health and safety, emergency preparedness, social support, conflict management, and risk factor reduction through lifestyle change. Finally, corporate strategies for containing worksite health costs without compromising the quality of employees' medical care need to be developed and evaluated in future studies.

Methodological Issues in the Design, Implementation, and Evaluation of Worksite Health Promotion Programs

Ecologically oriented analyses of health promotion encompass a broad range of theoretical and disciplinary perspectives (e.g., medicine, public health, the behavioral sciences, environmental design, urban planning, law, and public policy). They also emphasize the importance of developing comprehensive interventions that span multiple life domains (e.g., residential, occupational, recreational, and health care settings) and using multiple methods to assess the health and cost-effectiveness of these programs. Considering the broad scope and complex structure of community-wide health promotion programs, it is not surprising that they often prove to be too cumbersome to implement effectively or, at best, difficult to sustain over extended periods of time.

The challenges of implementing broad-based interventions raise several practical questions about how best to foster and sustain community-wide health promotion programs and encourage the transfer of medical, behavioral, and environmental change technologies from academic settings to corporations, community organizations, and government agencies. Additional challenges include the integration of multimethod strategies for evaluating the health and financial outcomes of worksite health programs, and the provision of health promotion, disease and injury prevention, and managed care programs for nonpermanent workers, unemployed individuals, and minority populations.

Organizational Infrastructure to Foster and Sustain Comprehensive Health Promotion Programs

An important focus for future research is the development of collaborative links between corporate, community, and health care settings to foster comprehensive health programs. Successful efforts to establish community-wide collaboration in the development of health promotion programs have been made by the Stanford Corporate Health Program,[4] the Stanford Five City Project,[122] and the lifestyle modification programs developed at the University of California, Los Angeles.[1,127] Important goals are to promote the sharing of medical archives and databases and to avoid an adversarial stance among the various interest groups participating in these programs.[128]

A second research focus concerns the development and refinement of methodologies to encourage community-wide exchange of research findings, educational programs, and innovative health promotion programs. Examples of these technology transfer strategies include the *U.C. Berkeley Wellness Letter*, circulated to nearly one million subscribers throughout the nation; the statewide distribution of the *Wellness Guide* and *La Guia del*

Bienestar to low-income residents of California; the *Healthtrac* risk appraisal and self-care programs;[119] and the *Catalog of the Stanford University Health Promotion Resource Center*, which provides low-cost access to the print and media materials used in Stanford Medical School research projects.

In the future, successful employee health programs will be those based on collaboration between the business community, medical service providers, insurance carriers, government agencies, and universities.[4,5] The anticipated growth of managed care and community rating systems in the United States is likely to prompt the development of integration technologies or employer-community liaison groups to ensure the coordination of health promotion and medical services for employees, whether they are provided at the worksite or entirely off-site. Some coordinating group or agency will need to take a broad, integrative view of health care to ensure that a particular catchment area is well serviced and that periodic appraisals of community health are monitored as a basis for health care decision making.

Developing Multimethod Strategies to Evaluate the Health Outcomes of Worksite Wellness Programs

The extent to which worksite health promotion programs result in improved health outcomes for their participants is a major criterion for judging their value. Empirical studies of changes in employees' health status as a function of their involvement in worksite health promotion programs become more convincing to the extent that they employ prospective research designs comparing individuals and/or worksites randomly assigned to intervention and control groups, and demonstrate a pattern of theoretically predicted causal linkages among behavioral and/or environmental changes; intervening cognitive, emotional, physiological, and interpersonal processes; and multiple criteria of illness symptoms or improved health status.[8,129] In recent years, a growing number of studies undertaken to evaluate the health impacts of worksite interventions have met the first methodological requirement.[4] However, field-experimental demonstrations of theoretically predicted relationships between intervention components, intervening processes, and health outcomes have been more difficult to achieve.[25,26]

A major challenge for future research is to develop theoretically based and broader gauged studies that specify linkages among hypothesized predictor variables, moderating and mediating factors, and multiple criteria for evaluating the health impacts of worksite interventions. Among the categories of measures that might be usefully combined in future studies are (1) genetic and behavioral risk factors for disease,[130] socioeconomic, demographic, and job status[131] to identify employees who are at highest risk for health problems; (2) behavioral and physiological processes that may render employees more or less vulnerable to health problems, including their lifestyle modification efforts,[127,132] psychoneuroendocrine processes,[133,134] hypertension,[135] psychological stress and coping strategies;[136,137,138] and (3) a variety of social and personal health outcomes including organizational conflict and cohesion,[23,62,139] employee illness symptoms,[36] injury rates,[140] and wellness levels.[24] By adopting a broader array of measurement strategies than has been used in the past, researchers will be better able to test hypothesized links among behavioral and environmental interventions, physiological and psychosocial processes, and disease or wellness outcomes.[8]

Another methodological approach that warrants greater attention in future studies is the use of "real time" measurement strategies for (1) recording patterns of emotional

response, health behavior, and physiology across different environmental contexts (e.g., at work, at home, and during the commute between home and work), and (2) providing feedback to employees about their levels of exposure to chemical pollutants. Real-time measures of workers' exposure to air contaminants[141] and random-event sampling of behavior and subjective experiences using electronic paging devices,[22] daily time budgets and activity logs,[92] telephone care and computerized housecalls,[4,38] and ambulatory blood pressure monitoring[142,143] are examples of innovative data-gathering techniques that could be usefully combined in future studies of worksite health.

Linking Measures of Productivity, Organizational Effectiveness, and Cost-Effectiveness in Worksite Health Program Evaluations

From both ethical and regulatory perspectives, employers are morally and legally bound to maintain healthful working conditions and to provide high-quality health programs for their workers, despite the fact that these programs require a substantial financial investment that affects the corporate "bottom line." Ideally, financial considerations should not diminish employers' efforts to provide high-quality work environments and health programs for their employees. However, it is important to recognize that corporate decisions to invest in and sustain worksite health programs are influenced by estimates of their anticipated cost-effectiveness and cost benefits. Therefore, developing improved measures of the financial and organizational outcomes of worksite health programs is an important task for future research. In particular, it is necessary to develop more standardized and uniformly acceptable definitions of terms such as cost-effectiveness, cost benefit, and productivity, which currently are defined in highly idiosyncratic ways, thereby precluding meta-analytic evaluations of the data from multiple studies.[3,27,33,144,145]

Appraisals of the cost-effectiveness of worksite health programs are based on estimates of direct, indirect, and net program costs. The direct financial costs associated with worksite health programs include expenditures for research and development, capital investment, and overhead associated with implementation and maintenance of interventions. Indirect financial costs include employees' time away from work and opportunity costs associated with their participation in health-related programs. Net costs reflect the difference between total financial expenses associated with a particular program and its total financial benefits (e.g., higher levels of productivity and reduced corporate expenditures for workers' injuries, illnesses, absenteeism, and attrition).[144,145] Cost-effectiveness is defined as net program costs expended per health benefits achieved.

Reliable estimates of cost-effectiveness, both prior and subsequent to the initiation of health-promotive interventions, have been difficult to calculate because the financial costs and health benefits associated with these programs are not always apparent (let alone measurable) in the short run. For example, the higher levels of energy and morale associated with improved physical health may eventuate, over time, in greater creativity and innovation among office workers. Yet these psychological and cognitive benefits of program participation are more difficult to calibrate than biometric health outcomes (e.g., reduced hypertension and cholesterol levels). Moreover, the corporate financial benefits (e.g., income from patents or operational efficiencies) associated with improvements in employees' mental health may become evident only after a prolonged period, rendering them less likely to be reflected in short-term cost-effectiveness or cost-benefit appraisals.

Future research on the cost-effectiveness of these programs can be improved in several respects. First, a wider array of productivity and organizational effectiveness criteria should be incorporated in future studies. Productivity refers to the quantity, quality, and timeliness of an employee's work performance. Organizational effectiveness is defined more broadly to include not only individualized measures of productivity but also aggregate rates of absenteeism, staff turnover and retention, frequency and quality of communication among coworkers, the corporation's image in the broader community, employee health, injury reduction, and morale at the level of work groups, departments, and whole organizations.[51,146-150] The conceptual and empirical links among diverse criteria of productivity, organizational effectiveness, and well-being warrant further study in future research.

Second, the relative cost-effectiveness of behavioral, environmental, and biomedical interventions based on primary prevention (reduction of injury or illness risk factors), secondary prevention (early detection and treatment of disease), and tertiary prevention (provision of medical and rehabilitative services to minimize morbidity and hasten recovery from illness or injury) is an important issue that should be evaluated more thoroughly in future research.[4,27,113,151]

Developing Health Promotion Programs for Nonpermanent Workers, Unemployed Individuals, and Minority Populations

One of the greatest challenges facing the field of worksite health and community health promotion, more generally, is to reduce disease prevalence among low-socioeconomic and minority populations—groups that are at greater risk for a variety of illnesses and for whom large-scale disease prevention programs have been shown to be less effective than for higher socioeconomic and nonminority populations.[131,152,153,154] These pockets of disease prevalence within low-income and minority populations suggest some important directions for the design and evaluation of worksite health programs that address the specialized needs of high-risk groups.

For example, most health maintenance organizations (HMOs), preferred provider organizations (PPOs), and managed care organizations (MCOs) have been designed to address the medical needs of permanent employees and their families, rather than those of nonpermanent workers, unemployed individuals, and indigent groups. Challenges for the future include (1) the broadening of HMO, PPO, and MCO programs to encompass a wider variety of wellness, disease prevention, and injury prevention services; (2) the development of new managed care options for vulnerable groups in the population that currently lack access to adequate health care; and (3) the development of employee assistance and community health programs to assist marginally employed and unemployed workers.[155]

Recently, important strides have been made toward achieving these goals through the establishment of healthy community initiatives in several states[124,156,157] and disease prevention programs for minority and indigent populations.[158-162] These efforts should be expanded in future research through further consolidation of managed care programs for permanent employees with innovative medical and preventive services that address the needs of underserved populations.

CONCLUSIONS

Our review of research developments and emerging directions in the field of worksite health programming suggests that a fundamental paradigm shift may be occurring, from individually targeted, organization-specific corporate wellness programs toward broader formulations that reflect the rapidly changing contexts of work and health. This broader view highlights the importance of linking organizational, educational, medical, technological, and regulatory strategies to enhance the health of employees and their dependents. The emerging paradigm is broadly concerned with the ecology of work and health.

Corporate wellness programs traditionally consisted of individually focused lifestyle change programs, organized and presented by employers for their workers at the worksite. Implementing and evaluating these isolated interventions on an organization-specific basis made sense when both the nature of work and its societal contexts were relatively stable. However, in the context of rapid societal change and powerful megatrends that are altering the structure, locations of, and incentives for work (e.g., current trends toward corporate downsizing and part-time employment, telecommuting and homework, and rising employer health costs), narrowly focused models and applications of worksite health programs are no longer adequate. Instead, a broader ecological perspective is required—one that views the workplace as part of a larger community system and accounts for the pervasive influence of changes in work organizations and technologies, household structures, the health care system, and the regulatory environment on employee well-being.

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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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The Integrated Model: Implications for Worksite Health Promotion and Occupational Health and Safety Practice

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Within a single firm it is common to find both occupational safety and health and worksite health promotion interventions operating in isolation from one another, with different intervention targets, methods, and personnel. Overcoming the segmentation of the two fields will require, among other things, the promulgation of an overarching model of work and health. The purpose of this article is to describe an integrated model and to show how it can be applied to improve worksite health interventions for both occupational safety and health and worksite health promotion. Practice examples from both fields are used to illustrate interventions that focus on different areas of the model (individual behavior, psychosocial, organization, and contextual factors). It is argued that occupational safety and health and worksite health promotion practitioners need to develop more comprehensive interventions and rigorously evaluate these programs to determine if they are more effective than programs with a more narrow focus.

INTRODUCTION

While both occupational safety and health and worksite health promotion seek to prevent work-related illness and injury and promote employee health, the two fields have traditionally operated independently. Within a single firm it is common to find both occupational safety and health and worksite health promotion interventions operating in isolation from one another, with different intervention targets, methods, and personnel. Occupational safety and health professionals have for the most part concerned themselves with the physical hazards of the work environment while worksite health promotion professionals have primarily concentrated on individual lifestyle behaviors. This is not

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surprising given that professionals in each field receive separate training with little overlap in curricula and intervention methodology. The fields also have separate institutions such as professional associations and journals.

For nearly 2 decades, conceptual frameworks have suggested that worker health is the result of a complex interplay of factors involving not only the individual and the immediate physical and psychosocial conditions of the work role, but also characteristics of the larger organizational and socioeconomic contexts in which the immediate work environment is embedded.[1] These frameworks, more recently termed *ecological frameworks*,[2,3] imply that while both worksite health promotion and occupational safety and health practitioners have focused their interventions on different factors, interventions that attend to multiple factors are likely to be more effective than those with a more narrow focus.

While there have been few empirical studies examining the relationship among individual, psychosocial, physical, organizational, and socioeconomic factors, the studies that have been conducted support the importance of considering the effect of multiple factors on workplace health important. For example, increased job stress (time pressure, piecework, hazardous exposure) has been associated with increased smoking behavior and sedentary behavior.[4,5] Similarly, researchers have found that sources of stress and psychosocial factors are associated with musculoskeletal injury.[6] Furthermore, there is evidence to suggest that health behaviors and environmental exposures act synergistically to negatively affect health. For example, "the asbestos worker who smokes is estimated to have eight times the risk of lung cancer as compared to all other smokers and 92 times the risk of non-smokers who have never worked with asbestos" (p. 292).[7]

The available empirical evidence and conceptual and theoretical analyses suggest that practitioners in both fields consider a wide variety of factors that influence their efforts to create change, including (but not limited to) factors typically considered within the purview of the other field. Moreover, practitioners from both fields could improve practice by collaborating in ways that incorporate the special expertise of each. There are, however, many obstacles to such collaboration that will not be easily surmounted. Overcoming the segmentation of the two fields will require, among other things, the promulgation of an overarching model of work and health, based on these ecological frameworks. Such a model needs to be broad enough to encompass the range of factors that both these worksite health specializations have been concerned with and, at the same time, specific enough to provide guidance in developing worksite health interventions in specific contexts.

The purpose of this article is to describe a model of occupational stress (the Integrated Model) that incorporates a broad definition of stress and includes, but is not limited to, the domains traditionally covered by both health promotion and health and safety practitioners. The Integrated Model is thus a model that can be helpful in integrating worksite health promotion and health and safety. As will be shown through multiple examples, the model also suggests strategies for developing worksite health interventions in both fields. Although studies suggest these factors are interrelated and examples of interventions exist, it is important to note that there is a paucity of evaluation data examining worksite interventions that address multiple factors. This suggests that it is important that programs using the Integrated Model be developed with rigorous evaluation designs, and that findings from these programs be disseminated in order to inform future work in this area.

THE INTEGRATED MODEL

The Integrated Model is based on previous work in the field, most notably the occupational stress framework developed by researchers at the University of Michigan and the Demand-Control Model.[8-14] The Demand-Control Model posits that it is the joint effects of high demands and low control that lead to negative health outcomes. The results of studies testing this model have been generally favorable.[11,12] However, the narrowing of the focus of inquiry that has helped to shed light on this relationship has also been a source of criticism of the model.[15,16,17] It has been argued that it is important to expand the definition of demands and control and to differentiate the effect of different types of control on health.[15,16,17]

The conceptualization of the stress process developed by researchers at the University of Michigan Institute for Social Research provides a framework for evaluating these differential effects. This framework suggests that the different aspects of constructs (e.g., control, social support) be evaluated separately to determine what aspects (individual, environmental, organizational, or social) of a construct are important under what conditions.[18] The framework has been widely used to examine the relationship between key psychosocial factors, occupational stress, and job satisfaction and health.[8,18,19] In contrast to the Demand-Control Model, this framework has been criticized for being too broad in its conceptualization of the stress process.[14] The Integrated Model incorporates the advantages and overcomes some of the limitations of both of these other models.

The Integrated Model incorporates a number of stressors, or objective conditions that are conducive to stress, and individuals' perception of these conditions as stressful. Although many traditional stress frameworks include only psychological factors as stressors, this model builds on previous work by suggesting that stressors may be a wide variety of demands and exposures and may include psychological factors as well as job, interpersonal, organizational, environmental, and physical demands. As can be seen in the model (Figure 1), these stressors may have direct effects on enduring health outcomes, or they may act through the perception of these events as stressful and affect short-term physiological, psychological, and behavioral responses. For example, a cataclysmic toxic exposure may have significant long-term effects on health regardless of the perception of the exposure as stressful or the physiological, psychological, or behavioral responses of individuals. Alternately, the effect of many demands and exposures—be they physical (chemicals, dusts, noise), interpersonal (supervisor hassles), or organizational (job security)—may be mediated by the perception of these conditions as stressful and the subsequent short-term responses. These short-term responses may be adaptive or maladaptive and may include individual lifestyle behaviors (e.g., smoking and exercise) and other behaviors such as use of personal protective equipment. Moreover, these behaviors may exist prior to and be exacerbated (or enhanced) by the stressor (e.g., increased smoking in response to increased task demands), or the response may be initiated by the stressor. In addition, the Integrated Model suggests that psychosocial factors, particularly social support and control, may have direct effects on short-term responses and enduring health outcomes or may affect the relationship of the stressors to these outcomes.[15] Although a complete review of the social network and control literature is beyond the scope of this article, some description of these terms is essential for understanding how they relate to worksite interventions.[20-23]

Social relationships, as considered in this article, fit most closely with the conceptualization of social relationships delineated in House, Umberson, and Landis.[22] According

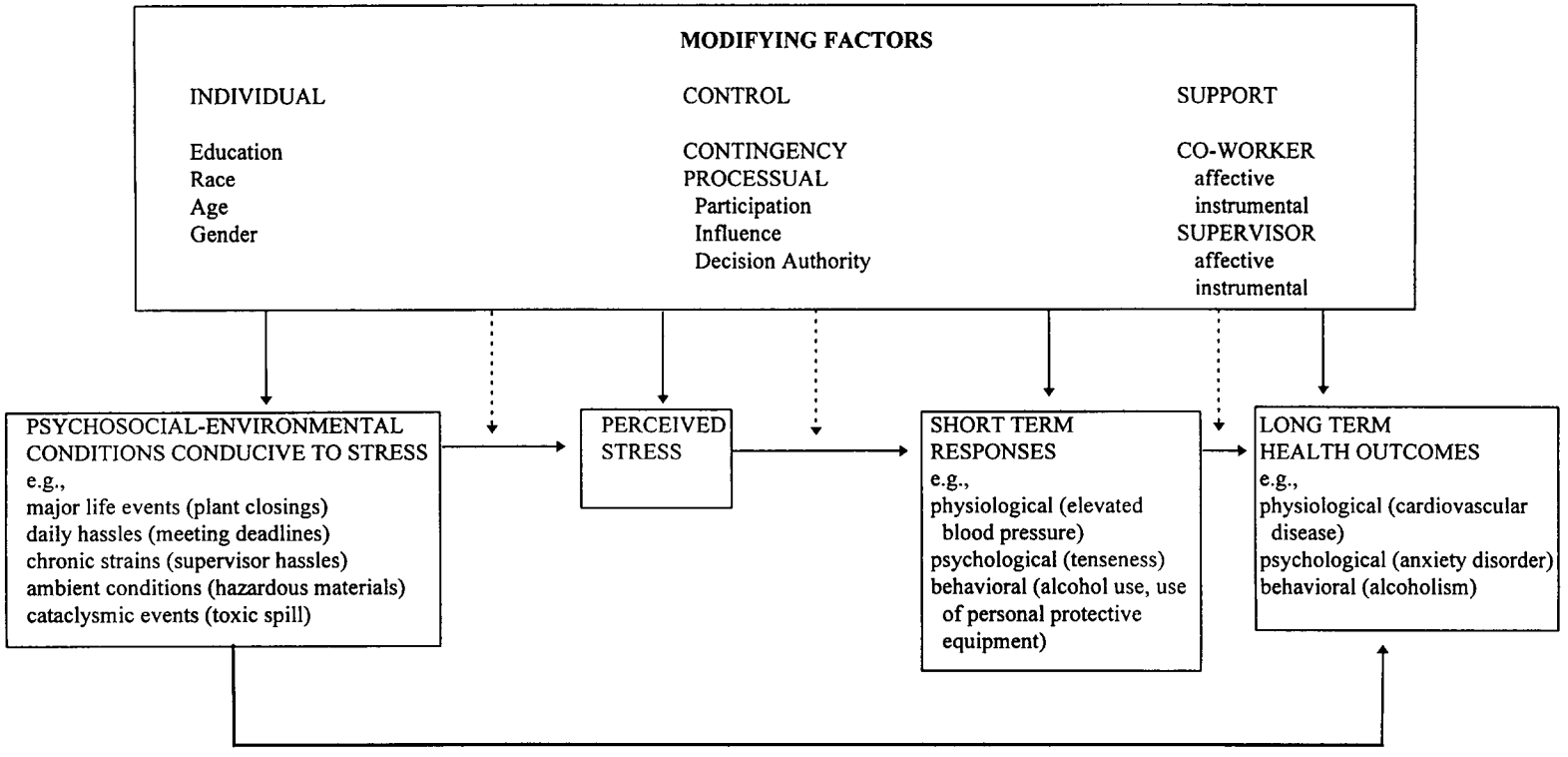

Figure 1. Integrated model.

NOTE: Solid lines between boxes indicate direct effects. Dotted lines indicate an interaction between the modifying variables and the variables in the box at the beginning of the solid arrow. This model assumes feedback loops, for example, between health and stressors. These feedback loops are not shown here. The size of the boxes does not reflect the importance of the various factors in the model.

SOURCE: Caplan et al. (1975),[8] Katz and Kahn (1978),[1] Karasek (1979),[11] House (1981),[18] Johnson and Hall (1988),[13] Israel et al. (1989),[19] and Chapman et al. (1990).[61]

to House et al., it is important to consider the following in order to understand the nature of social relationships: social integration or isolation (existence, quantity, or frequency of social contact); social network structure (reciprocity, homogeneity, size, durability of social contacts); and relational content including functional aspects or social support (affective, instrumental, appraisal, informational), relational demands or conflicts, and social and organizational regulation (norms, pressures, and policies). Many positive and negative aspects of social relationships have been shown to affect health in the worksite.[18,20] The job stress literature has focused primarily on the effects of social support, demands and conflicts (negative aspects of relationships), and organizational regulation (policies).

Two different conceptualizations of control—contingency control and processual control—are most relevant to the current discussion.[15] For purposes of this article, contingency control is defined as presented by Lewis[21] and refers to the belief that one's actions will lead to a desired outcome. This is similar to concepts such as locus of control and outcome efficacy.[21,24,25] Processual control refers to the ability to engage in the decision-making process. Individuals or groups may engage in the decision-making process by participating in the process (participation), having some capacity to influence the process (influence), or by having the capacity to make decisions (decision authority).[21] Previous research suggests that influence, not participation per se, is positively associated with job satisfaction[19] and that participation without the ability to influence may have deleterious effects on health.[15]

IMPLICATIONS FOR INTERVENTIONS

The Integrated Model provides a broad conceptualization of occupational health, thereby incorporating areas that are of concern to both worksite health promotion and occupational health and safety practitioners. The model suggests that health is the result of the interrelationships among a number of factors. It is, therefore, important that practitioners who design interventions aimed at one area in the model (e.g., short-term responses such as individual behavior) understand the effects of the other factors in the model on the targeted area and on health outcomes. For example, a practitioner developing a program concentrating on altering short-term responses (individual behavior change)—be it smoking or use of personal protective equipment—needs to consider the effect that organizational factors, social support, and control will have on the desired behavior changes, as well as the direct effect that these factors will have on health outcomes.

More specifically, applying the Integrated Model as a guide for developing interventions suggests that

1. practitioners can intervene with a focus on any of the factors in the model, including eliminating the stressors, enhancing psychosocial modifying variables, changing short-term responses and behaviors, or helping workers deal with long-term enduring health consequences;
2. the effectiveness of programs that focus on individual behavior change or stressors can be enhanced by strengthening psychosocial resources such as social support and control;
3. practitioners should consider using comprehensive approaches that address individual, psychosocial, environmental, and organizational factors, as well as broader policy issues that affect occupational health.

The remainder of the article will describe current practices in worksite health promotion and occupational safety and health, and provide specific examples of worksite health promotion and occupational safety and health interventions that incorporate strategies suggested by the Integrated Model.

WORKSITE HEALTH PROMOTION

Worksite health promotion practitioners tend to focus their interventions on changing individual lifestyle behaviors that have been associated with the most common chronic diseases (e.g., smoking, diet, and exercise) and enhancing psychosocial resources.[2] The worksite is viewed by employers and practitioners alike as an ideal environment for these program activities. Many employers view health promotion activities in the worksite as a means to create a healthier workforce that is more productive and requires less health care expenditures.[26] For health educators, the worksite provides ready access to program participants and hence the opportunity to decrease the negative effects of unhealthy lifestyle behaviors.

The National Survey of Worksite Health Promotion Activities (1989) found that approximately two-thirds of companies with more than 50 employees have some sort of health promotion activity addressing these lifestyle behaviors, including health risk appraisals, smoking cessation, blood pressure control, nutrition education, exercise, weight control, and stress management.[27] The most highly regarded among these programs (e.g., Johnson & Johnson Live for Life) focus at the level of individual behavior change with social and environmental changes made to the extent they are necessary to effectively produce this individual behavior change.[26,28,29,30] Such environmental modifications may include creating no-smoking areas, identifying high- and low-fat foods served in cafeterias, or providing exercise facilities.[29]

Although there have been significant contributions from worksite health promotion programs,[28-33] there are limitations to the impact programs focusing on individual behavior change can have on health outcomes if they do not also address other factors.[34,35,36] In particular, it is important to address psychosocial factors, the structure of work, and exposure to hazardous working conditions, all of which have been found to have significant effects on health outcomes:

> Satisfaction with work appears to be the best predictor of longevity—better than known medical or genetic factors—and various aspects of work account for much, if not most, of the factors associated with heart disease. Dull and demeaning work, work over which the worker has little or no control, as well as other poor features of work also contribute to an assortment of mental health problems. . . . Other factors are undoubtedly important—diet, exercise, medical care, and genetic inheritance. But research findings suggest that these factors may account for only about 25% of the risk factors in heart disease, the major cause of death. That is, if cholesterol, blood pressure, smoking, glucose level, serum uric acid, and so forth, were perfectly controlled, only about one-fourth of coronary heart disease could be controlled. Although research on this problem has not led to conclusive answers, it appears that work role, work conditions, and other social factors may contribute heavily to this "unexplained" 75% of risk factors. (pp. xvii)[37]

OCCUPATIONAL HEALTH AND SAFETY

As with worksite health promotion, occupational safety and health practitioners tend to focus on a somewhat narrow portion of health in the worksite, namely, preventing and minimizing the negative health effects of work-related injury and disease. When developing interventions, occupational health and safety practitioners use a variety of strategies, with a clearly stated hierarchy of what are considered the most reliable and efficacious interventions. The Office of Technology Assessment[38] indicates that it is preferable to eliminate the source of the hazard (e.g., substitution of chemicals and changes in engineering processes) followed by control of the transmission of hazardous substances through, for example, ventilation or isolation. Finally, interventions may focus on control of the worker, for example, administrative procedures, work practices, and personal protective equipment.[38] Many of the earliest occupational health and safety efforts to minimize work-related injury and disease began with changes in engineering processes, specifically improving machinery and equipment.[38] Occupational health and safety practitioners have continued to fight for engineering controls when possible, and have passed legislation that requires health and safety training.[39]

However, occupational health and safety activists argue that employers often seek health and safety interventions that appear to be the least expensive means of complying with regulations, usually with a focus on getting workers to change their behavior.[38,39] These interventions attempt to increase worker knowledge, change individual behavior, and may modify the environment to the extent that such modifications make individual behavior more effective in reducing the effect of the hazard.[38,40,41] Thus interventions most frequently include the provision of specific personal protective equipment (e.g., cooling garments and rubber gloves), the provision of education on how to perform certain behaviors (e.g., how to use personal protective equipment, recapping needles, improving flexibility and strength), or the provision of knowledge through trainings, posters, booklets, discussions, and lectures (e.g., information on hazardous chemicals).[42]

LIMITATIONS OF WORKSITE HEALTH PROMOTION AND OCCUPATIONAL SAFETY AND HEALTH PROGRAMS

Both worksite health promotion and occupational safety and health interventions tend to have a fairly narrow focus. The Integrated Model, an ecological framework, suggests that such a narrow view, regardless of its focus, will be less effective than programs that attend to the multiplicity of psychosocial and contextual factors that affect the health outcome of interest.[38,42,43] This suggests that it is necessary to develop interventions that address the stressors as well as the short-term responses to these stressors.

It is also critical for practitioners to understand that interventions in any area may be hindered by inadequate attention to psychosocial modifying factors (particularly social support and control) and organizational policies. For example, use of personal protective equipment may be effectively taught and learned but is ineffective if workers do not have access to the equipment.[44] Workers may understand the proper procedures for removing hazardous waste but will not demand these procedures be adhered to if doing so will cause conflict with coworkers or make it more likely that they will be laid off. Alternately, workers may not see the utility in stopping smoking when they are forced daily to breathe

the toxins from their work processes. As these examples suggest, a narrow focus (particularly focusing on individual behavior change) can be enhanced by strengthening psychosocial resources such as social support and control and by using more comprehensive approaches that address multiple factors (behavioral, psychosocial, and organizational) and acknowledge the relationship between health promotion and health and safety.

STRENGTHENING PSYCHOSOCIAL RESOURCES—SOCIAL SUPPORT AND CONTROL—WITHIN INDIVIDUAL BEHAVIOR CHANGE PROGRAMS

There are examples of both worksite health promotion and occupational health and safety interventions that have incorporated psychosocial factors to some degree. As the examples presented below suggest, worksite health promotion programs have tended to use the findings from the social support literature, while occupational health and safety practitioners have attempted to enhance control into their interventions.

Psychosocial Resources: Worksite Health Promotion Program Examples

Although most worksite health promotion programs focus on individual behavior change, some practitioners have incorporated what is known about social relationships, primarily social support, as a mechanism to improve the effectiveness of their programs.[45] These programs have generally directed their efforts at increasing social support among coworkers or family members to enhance individual behavior change.

Building coworker support for initiating and maintaining healthful lifestyle changes has been incorporated into health education programs in several ways. For example, one program used buddy systems as a way to encourage smoking cessation and found a decline of self-reported smoking prevalence from 29% to 18% over a 6-month period.[46] When asked, participants cited social pressure (what could be considered social regulation within the House et al. framework)[22] from family and coworkers as one of the most salient reasons for quitting.[46] Another program developed support groups to assist employees who had taken part in a lifestyle change program such as smoking cessation. These support groups provided "a supportive, sympathetic environment in which to continue to initiate or maintain hard-won changes in health behavior habits" (p. 312).[32]

In another study, Erfurt, Foote, and Heirich[33] compared the effects of four different interventions. The first involved a wellness screening; the second a wellness screening and health education; the third included the above plus follow-up counseling; and the fourth site added to the activities of the other sites by establishing health communication networks, peer support groups, buddy systems, specific health promotion group classes, and plantwide health promotion activities. Their results indicated that the fourth site had the "greatest degree of health improvement, overall, across the four sites" (p. 446).[33]

Social relationship concepts have also been incorporated into traditional individual behavior change programs at the worksite by acknowledging the importance of family and nonwork relationships when developing healthier lifestyle behaviors. One example of this is sending newsletters to employees' homes to inform the employee as well as family members about healthier living.[36,45] Other programs have provided the opportunity

for the entire family to participate in worksite health promotion programs and have encouraged the whole family to take part in new lifestyle behaviors such as walking.[45]

Although results from these programs have indicated that enhancing social support facilitates individual behavior change, some have argued that it is important to consider the role of organizational regulation, particularly policies, and how it affects individual behavior and health outcomes.[47] In some instances, organizational policies may exacerbate work-family conflicts. For example, organizational policies such as forced overtime may negatively affect family life by causing child care problems. This suggests that in considering psychosocial factors it is important to consider how they may affect health outcomes, the acquisition of new behaviors, and whether they may act as stressors in the work environment (i.e., interpersonal stressors). These issues will be addressed in more depth in the section "Comprehensive Approaches to Occupational Health."

Some health promotion programs have included efforts to increase control. For example, some programs have incorporated the use of employee advisory boards to inform and improve the implementation of programs to create individual lifestyle behavior changes.[48] Recent reviews suggest, however, that attention to control remains uncommon in worksite health promotion programs.[49] Attempts to increase control within occupational health and safety programs is, however, more common.

Psychosocial Resources: Occupational Health and Safety Program Examples

Although state and federal regulations and funding sources may require health and safety programs to transmit certain information and skills, the approach taken to accomplish this goal is not specified. A recent volume of the *American Journal of Industrial Medicine*[40] provides several examples of programs that use approaches to build employee control while at the same time addressing a specific health and safety issue or concern (e.g., right-to-know training and information about particular hazards such as ethylene oxide). Many of these programs enhanced control by using participatory training techniques to empower workers; that is, involving workers in the implementation and/or evaluation of the training activities. For example, several projects developed training activities that incorporated the specific exposures and experiences described by workers participating in the intervention.[50,51,52] In one instance this entailed using a list of hazards generated by the training participants and photographs taken at the site.[50] Activities were also developed to encourage participants to work as a group to respond to situations where they encountered certain chemicals in their worksite.[50,51,52] This type of joint problem-solving activity enabled workers to use the information provided (e.g., how to use a Material Safety Data Sheet or a National Institute for Occupational Safety and Health pocket guide) as well as discuss specific barriers that make it difficult for them to perform the actions suggested by the training session.[50,51]

Participatory training techniques help workers to improve their capacity to perform certain behaviors and increase their knowledge about regulations and their rights, hence enhancing their sense of control *within* the situation. However, it has been argued that to decrease occupational illness and injury it is necessary for workers to have control *over* their working conditions.[53] Participatory training activities in and of themselves are unlikely to influence broader types of control unless they are accompanied by a number of other factors.[50,51] In order to exert control over working conditions, it is important for workers to be able to exert influence and define *what* interventions need to occur (not just

participate in or inform expert defined programs), and these interventions need to address multiple factors (i.e., it is important to use participatory comprehensive approaches).

COMPREHENSIVE APPROACHES TO OCCUPATIONAL HEALTH: LESSONS LEARNED

Participatory comprehensive approaches to worksite health promotion and occupational health and safety address several points in the Integrated Model, such as individual behaviors and psychosocial factors (particularly social support and control). These programs also emphasize the importance of reducing the underlying factors associated with health problems (i.e., individual, interpersonal, organizational, and environmental [physical] stressors). In addition, these programs may act to influence broader contextual factors, such as social conditions and legislative reforms, that affect both organizations and individuals. Moreover, these approaches are participatory in that they include the multiple parties affected by the program at all levels of program activity, including design, implementation, and evaluation. Although there are relatively few examples in the literature of this type of approach, three programs—the Oil, Chemical and Atomic Workers International Union's (OCAW) Work and Family Program,[47] the Stress and Wellness Project,[54] and the Labor Occupational Health Program's (LOHP) VDT Coalition[58]—illustrate some of the defining characteristics, common experiences, and lessons learned in using this type of approach.

The OCAW's Work and Family Program[47] originated in pharmaceutical and plastics plants in the mid-Atlantic region of the United States. The main activities were to "change and improve employer policies that have a stressful effect on union members' personal lives . . . and to provide mutual aid to [union] members by assisting with information and referral to organizations in the community which can assist with personal and family problems" (p. 164).[47]

The Stress and Wellness Project[19,54,55,56,57] was implemented in an automobile components parts manufacturing plant in Michigan. The project aimed to understand and reduce sources of occupational stress and strengthen psychosocial factors thought to affect the relationship between these stressors and health.[54]

The LOHP VDT Coalition[58] is a "group of unions and individual workers concerned about health and safety for VDT operators. . . . Together with university-based professionals these workers did their own research, . . . precipitated the first study of VDT hazards . . . and shared strategies for improving working conditions" (p. 692).[58]

One similarity of these programs is that each included interventions that targeted several different points in the Integrated Model. For example, OCAW's Work and Family program provided information and resources to encourage individual behavior changes such as improving child-rearing practices and decreasing substance use.[47] The program also enhanced social support and control through the development of committees that provided the opportunity for workers to take part in the process of defining and developing interventions to address the problems they were encountering. In addition, their program assessed and targeted organizational stressors, including policies that interfered with workers' abilities to balance work and family responsibilities (such as forced overtime).[47]

The Stress and Wellness Project also included interventions aimed at a number of points in the model.[54] For example, the project enhanced control and social support by developing the Stress and Wellness Committee. This committee took an active role in

assessing needs, developing interventions, and evaluating program activities. In addition, the committee spent considerable time developing a sense of group identity (e.g., establishing group norms, working together for common goals). Through their activities the committee identified and developed intervention strategies aimed at reducing four major stressors: lack of participation in decision making, hassles with supervisors, the tension between producing quantity and quality parts, and lack of information and communication. The committee also conducted a worksite health promotion program, HealthWatch, that focused on changing individual lifestyle behaviors.

Similarly, the Labor Occupational Health Program's VDT program intervened at a number of different points in the model.[58] The program encouraged individual behavior and environmental change by providing information to workers and helping workers to design better workstations. The program also enhanced control in a number of different ways. The coalition trained workers to investigate hazards in their worksite. This led to union surveys and a request for an outside health hazard evaluation.[58] The coalition also addressed broader policy issues by providing workers with skills to lobby for organizational and legislative changes related to video display terminals.[58]

In addition to developing interventions to create change at multiple points in the model, to some extent each of these comprehensive programs engaged in a process of system development.[55] This may have been through the development of a specific committee or the opportunity to join a coalition of people who were addressing similar issues. In the cases where a committee was formed, the constituency of the group was critical. The experience of both the OCAW's Work-Family Committee and the Stress and Wellness Committee suggest that it is important for committee members to know about the particular site of interest, be "natural leaders," have the trust and respect of their coworkers, and have good communication skills.[47,55]

System development also required that committee members develop the "competencies to engage in the cyclical process of diagnosing and analyzing problems, and planning, implementing and evaluating interventions aimed at meeting identified needs" (p. 155).[55] This often involved what might be considered technical and process skills, rather than content-specific skills, including development of group norms and skills for shared influence within and outside of the group, development of needs assessment techniques including how to conduct interviews and surveys, communication of findings including public speaking, development of interventions based on assessment of needs, implementation of programs, public advocacy, and evaluation. In addition, some programs included collective bargaining and negotiation skills as well as information about grievance and arbitration procedures.[47,55,58] Each of the programs reviewed also pointed to the benefits of incorporating people from a variety of disciplines in order to build these different skills.[47,55,58]

The progression of the interventions within a participatory comprehensive approach may vary to some extent. Interventions may occur sequentially with each focusing on a discrete point in the model. Alternately, several interventions, each addressing a specific or discrete point in the model, may occur simultaneously. Finally, a single systemic intervention may attempt to incorporate change at many points in the model. Results from the Stress and Wellness Project suggest that in order to achieve real changes it may be necessary to move from discrete interventions for discrete problems to more integrated and systemic interventions for systemic-level problems.[55]

This more comprehensive approach to occupational health also suggests that one of the most effective targets for creating change may actually be outside the occupational setting per se, namely legislative reform. It has been argued that legislative reform is

required not only to address known physical and chemical hazards but also to address issues of work reorganization.[59] These reforms might allow workers to stop production, without negative repercussions, if they see a hazard established in Swedish work environment policies.[60] In addition, standards might be included to address underlying stressors such as machine pacing, job insecurity, worksite isolation, work-family conflict, or technological change.[16,47,59]

The participatory comprehensive programs reviewed point to the need for active involvement of workers, worker's institutions (unions in unionized settings), and outside specialists in the assessment of needs and development of interventions. Without this active involvement worksite health promotion and occupational safety and health practitioners may find, for example, that workers (and unions when workers are unionized) oppose their interventions because the program was initiated by management without consulting or including workers (or their unions). In unionized settings there is also a concern that certain programs may enter into areas that traditionally have been reserved for collective bargaining.[15,42] Developing programs that enter into these areas takes power and control away from the collective bargaining process and hence may be viewed as a threat to union processes. In cases such as these, refusing to take part in an intervention may be viewed as compromising potential short-term health benefits in the interest of more broadly defined long-term health gains. It is critical that as practitioners seek to enhance control and social support they do not inadvertently eliminate the control and social support that already exist. It is also important for practitioners to realize that labor/management relations are likely to affect the response to *any* program that is brought into the worksite regardless of its assumed neutrality or benefit.[60] Involving the various parties in the process of developing and implementing the interventions can help to avoid some of the problems and maximize the potential for successful programs.

Finally, the participatory comprehensive approaches reviewed here are based on the premise that health outcomes are the result of multivariate and complex processes, and as such, expertise and information in a single area is not in and of itself sufficient to promote occupational health. It is, therefore, judicious to enter into the process of change with a multidisciplinary team that includes expertise in many different areas. This requires that practitioners not only be able to take on different roles such as expert and problem solver, but also be able to work in teams involving practitioners from different disciplines. Teamwork entails sharing control of the process and content of interventions. For example, if there is a sequential process in a comprehensive intervention, one member of the team, the toxicologist, may have a primary role at one point in time in designing and leading a training session on hazardous waste, while other members may at that point be small-group facilitators, problem posers, or observers. During efforts to develop a smoking cessation program, the health promotion practitioner would take the lead in program design and implementation, while the toxicologist might take the observer role or pose problems based on his or her experience from the previous intervention (e.g., How does exposure to toxins affect workers' intentions to quit smoking?).

CONCLUSIONS

The Integrated Model suggests that no single intervention to improve health in the worksite is likely to be sufficient. Because of the mutual influences of individual behavior, psychosocial, organizational, and contextual factors, it is incumbent upon both worksite health promotion and occupational health and safety practitioners to develop participatory

comprehensive programs using a multitude of strategies that are appropriate for the intended area(s) of change and acknowledge the mutual influences of the factors in the model. This suggests, for example, that practitioners who wish to create changes in individual lifestyle behaviors or improve use of personal protective equipment might attempt to build psychosocial resources, particularly social support and control, by using strategies that enhance these psychosocial factors in their behavior change program activities. This could include group activities to enhance social support (buddy systems, peer support groups, inclusion of family members through information sharing and activities) and/or mechanisms to include workers in the design, implementation, and evaluation of program activities. Similarly, in attempting to address these behavioral factors, practitioners might want to consider the underlying factors associated with these behaviors and subsequent negative health outcomes. This may lead practitioners to evaluate, develop, and advocate for organizational, state, and federal policies to improve worksite health (e.g., eliminating toxic chemicals and hazards, fostering work-family policies, and policies that affect worker control).

Because participatory comprehensive approaches require the involvement of practitioners from multiple disciplines, both worksite health promotion and occupational safety and health practitioners need to recognize that any one area of expertise is necessary but not sufficient to create needed worksite changes. Both worksite health promotion and occupational safety and health practitioners have a variety of skills that are advantageous not only for their own program activities but also to facilitate more comprehensive approaches. For example, worksite health promotion practitioners who have degrees in health education often have group process and facilitation skills that are useful in developing the relationships required to work with others. Health educators also have training in the theory and practice of individual behavior and organizational change strategies that might enhance interventions developed by health and safety practitioners. On the other hand, occupational health and safety practitioners have experience and expertise in effecting organizational, state, and federal policy changes. In addition, many occupational health and safety practitioners have a history and understanding of working together with workers, unions, and management that would benefit health promotion practitioners.

Participatory comprehensive approaches may push worksite health promotion and occupational safety and health practitioners to newly defined and difficult territory not only in terms of learning new skills from workers, managers, employers, and each other, but also in terms of funding. It is critical for practitioners to understand that integrating is not appropriating. The Integrated Model suggests that it is helpful to learn about and build upon expertise that exists in each field, not that one should replace the other. This is particularly crucial to understand in these financially difficult times. Most funders provide categorical funding in one particular area of interest. In addition, funders are often interested in concentrating on one level of change, be it individual behavior or organizational or policy-level changes. If, as the model suggests, it is necessary to address multiple factors at multiple levels, it may be necessary to concentrate on a "case" such as a single organization and work together with other health practitioners to build resources to address different points in the model within the case. This may be advantageous in that skills learned in one area can be transferred to another area of intervention, creating overall improvements in program outcomes. However, some alteration in perspectives may be required such that practitioners from diverse fields and their interventions need to be viewed as complementary rather than competitive. Moreover, it is important to begin to consider long-term, rather than short-term, definitions of change

and intervention effectiveness. Although it will not be easy to overcome the many challenges presented by comprehensive approaches, success in doing so is likely to enhance worker health and well-being.

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Worker Participation in an Integrated Health Promotion/Health Protection Program: Results From the WellWorks Project

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According to prior reports, blue-collar workers are less likely to participate in worksite health promotion programs than are white-collar workers. This study examined worker participation in the WellWorks worksite cancer prevention intervention, which integrated health promotion and health protection. Analyses were conducted to assess relationships among participation in health promotion and health protection programs, and workers' perceptions of management changes to reduce potential occupational exposures. Results indicate that blue-collar workers were less likely to report participating in health promotion activities than white-collar workers. A significant association was observed between participation in nutrition- and exposure-related activities, suggesting that participation in programs to reduce exposures to occupational hazards might contribute to blue-collar workers' participation in health promotion activities. Furthermore, when workers were aware of changes their employer had made to reduce exposures to occupational hazards, they were more likely to participate in both smoking control and nutrition activities, even when controlling for job category. These findings have clear implications for future worksite cancer prevention efforts.

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INTRODUCTION

The ever-widening gap in disease risk by socioeconomic status underlines the need for effective cancer control strategies for those less educated, with low incomes, and working in low-status jobs. For example, education has now replaced gender as the primary predictor of smoking status,[1,2] and healthy dietary habits are more prevalent among those with greater education[3] and higher income.[4] Similarly, blue-collar workers are more likely to be smokers than workers in white-collar jobs,[3,5,6] and are twice as likely to have multiple risk factors (e.g., smoking, high-fat diets, and sedentary lifestyles).[7] Occupational exposures also are high among blue-collar workers; one study found that 75% of craftspersons and laborers reported occupational exposures, compared to no more than 9% among white-collar workers.[9] Workers reporting exposures to occupational hazards have higher smoking rates than workers without such exposures.[8]

Worksites are an important channel for disease prevention and health promotion efforts.[10,11,12] However, recent intervention studies have underlined the challenges facing worksite programs in producing significant behavior changes. For example, at the conclusion of the 2-year Take Heart project, a randomized study of 26 worksites, no significant differences were observed between the intervention and control groups in smoking rates, dietary intake, or employee cholesterol levels.[13] In the recently concluded Working Well Cooperative Trial conducted in four study centers, modest but significant differences in dietary patterns were observed between the intervention and control sites for the trial overall, but no trialwide effects were observed for smoking cessation. A significant effect for smoking cessation was observed only at the study center implementing an integrated health promotion/health protection intervention.[14]

For worksite-based interventions to be effective with blue-collar workers, public health professionals may need to expand the scope of traditional health promotion programs by identifying and addressing workers' concerns. In addition to having a poorer behavioral risk profile, blue-collar workers are more likely than other workers to be exposed to occupational hazards.[9] For blue-collar workers, the top health priorities may not be the behaviors addressed by "traditional" worksite health promotion programs (e.g., diet, exercise). Instead, the risks of highest concern may be those identified as key priorities in risk communication research: those that are involuntary, outside personal control, undetectable, and that seem unfair.[15] In the eyes of these workers, individual health behaviors may fall within a "zone of nonacceptability" for management actions.[16] That is, workers may view management efforts to address health-related behaviors like smoking cessation and nutrition as overly intrusive. Workers may similarly view management efforts in support of health promotion as a "smoke screen," diverting attention and resources away from management's responsibilities for job-related health and safety issues.[17,18] Therefore, reduction of occupational hazards may be a higher priority to workers than their own personal health behavior changes. Furthermore, management actions to reduce job risks may be required to gain credibility with this audience, and to increase its receptivity to health education messages about individual health behaviors.[8] Similar conclusions were reached in a recent study of a New England manufacturing firm:[9] wellness programs that fail to address the hazards of work may miss significant sources of health-related problems and costs, both to individual workers and employers.

In addition, health protection programs that ignore personal risk factors may underestimate workers' understanding of the complexities of health and well-being.

Exposures to work hazards may actually increase workers' motivation to adopt healthier behaviors. In a recent examination of data from craftspersons and laborers, we found that smokers exposed to hazardous substances in their jobs were over two times more likely than their unexposed coworkers to be thinking of quitting or taking action to quit smoking, even when gender, race, and education were controlled. Among workers exposed to job risks, concern about their job exposures was significantly associated with intentions to decrease dietary fat and to increase fruit and vegetable consumption.[8]

With such heightened interest in behavior change, one might hypothesize that workers exposed to occupational hazards may be more likely to participate in health promotion programs, since program participation is often a first step in behavior change.[19] However, multiple studies have reported that blue-collar workers are less likely to participate in worksite health promotion programs than are white-collar workers.[20-24] When they do participate in health promotion programs, prior results have shown that blue-collar workers are less likely than other workers to change their health behaviors.[25] This article examines factors that may be associated with blue-collar workers' participation in health promotion programs. Specifically, based on the literature cited above, we examine the following hypotheses:

1. Participation in health promotion programs is lower among craftspersons/laborers than other workers;
2. Participation in health protection activities is associated with participation in health promotion activities;
3. Workers' perceptions of management actions to reduce potential occupational exposures are associated with participation in health promotion programs.

THE WELLWORKS PROJECT

Data were collected as part of the WellWorks worksite cancer prevention project, a randomized controlled study of an integrated health promotion/health protection intervention.[26] The WellWorks study included 24 worksites located in eastern and central Massachusetts. Worksites were randomly assigned to intervention and control conditions immediately following a baseline survey of a random sample of workers from each worksite. WellWorks was one of four intervention research centers* participating in the Working Well Cooperative Agreement.[11] This randomized worksite intervention trial tested the effectiveness of health promotion interventions targeting nutrition and smoking in 57 matched pairs of worksites, using common elements of design, data collection and analysis, and intervention standards. Only the WellWorks Project in Massachusetts assessed the effectiveness of a model integrating health promotion and health protection.

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The WellWorks Worksites

The WellWorks Project recruited worksites from the Dun and Bradstreet Direct Access Database based on the following criteria: number of workers (250-2,500), turnover rate (<20%), non-English speaking (<20%), and probable use of a known or suspected occupational carcinogen. Of the companies considered, 160 were eligible and invited to participate; 24 (15%) agreed to participate. Standardized occupational hazards reviews conducted by a certified industrial hygienist confirmed the presence of occupational exposures within these 24 worksites, and documented the potential for exposures to hazardous materials. The types of business in the final sample included manufacturers of industrial, chemical, and other products; textile dying; firefighting; and newspapers. All worksites participating in WellWorks agreed to be randomly assigned to intervention condition, to administer employee and organizational surveys, and to deliver the intervention based on their assignment to group.[26]

The WellWorks Intervention

The 2-year WellWorks worksite cancer prevention intervention integrated health protection and health promotion activities aimed at both individual and worksite changes related to tobacco control, reduction of the potential for exposure to occupational carcinogens, and decreased consumption of dietary fat and increased consumption of dietary fiber. The WellWorks intervention was based on the ecological model of health promotion,[27,28,29] which provides a mechanism for linking health promotion and health protection because it emphasizes a shared framework for worksite change in which both individual behaviors and the environment are targeted. As in the Working Well project overall, the WellWorks intervention model applied three key elements: (1) joint worker and management participation in program planning and implementation, (2) consultation on worksite changes, and (3) coordinated programs targeting health behavior change.

The first key element of the WellWorks model, joint worker-management participation in program planning and implementation, was used to foster a sense of "ownership" and build skills for program implementation beyond the funding period.[29,30,31] WellWorks formed joint worker-management Employee Advisory Boards (EAB), whose role was to advise and participate in planning, promotion, and implementation of intervention programs.[32] The EAB provided a vehicle for discussion of both health promotion and health protection, and raised worker awareness of these dual components of worker health. This board informed project staff of employees' wants and needs for programming, and in turn conveyed the program's objectives and educational messages to the workforce.[33]

The second key element of the WellWorks integrated intervention model was consultation on changes in the worksite environment, which play a crucial role in worker health.[27,28,29] Worksite changes, especially those that involve management action, can also communicate a message to workers that their employers are committed to their health.[9] We promoted worksite-level change in all three risk factor domains (i.e., smoking, nutrition, and occupational exposures) by providing consultation to management. The consultation was aimed at reducing occupational exposures and was based on a model that posits a hierarchy of controls;[34] that is, the ideal choice is the substitution of safer substances for potential carcinogens. The next best choice is the use of engineering controls such as ventilation systems. The use of personal protective equipment is a last line of defense used in conjunction with engineering controls or when substitution and

engineering controls are not possible. The consultation included a review of the companies' Material Safety Data Sheets (MSDSs), an industrial hygiene walk-through assessment, and written and oral reports of findings and recommendations. The consultation on tobacco control policies emphasized smoking bans as the policy of choice to reduce workers' exposures. Consultation and training on creating an environment supportive of healthy eating focused particularly on fat and fiber and promoted changes in the cafeteria and vending machine selections.

The third key element of the intervention model, coordinated educational programs in all three risk factor areas targeting individual-level change, is the focal point for this article. To promote individual behavior change, educational activities were delivered in each worksite for each of the three risk factor areas. Following the Working Well protocol, these activities and materials included brochures, flyers, posters, self-assessments with feedback, self-help materials, educational campaigns, and group educational sessions. The EAB assisted in tailoring the activities to meet the needs and exposures of each individual worksite. Each worksite established a resource center containing educational materials addressing the three risk areas, including written materials, video cassettes, and posters. Worksite-wide activities were used to stimulate behavior change and increase awareness of occupational hazards. For example, a quiz contest called "Occupational Health Jeopardy" was developed as a means of increasing awareness of occupational hazards. In some worksites, combined health promotion/health protection events were delivered on the shop floor. For example, dietary self-assessments, taste tests, and carbon monoxide monitoring to promote smoking cessation were combined with an opportunity to "ask the industrial hygienist" questions.

Classes or skill-building groups were also offered in each of the risk factor areas. Educational opportunities for individual workers regarding reading MSDSs and the use of personal protective equipment were provided through traditional hazard communications training and contests focused on the correct identification of chemical hazards by reading MSDSs. Although not all workers reported working directly with hazardous substances, all workers were eligible to participate in the health protection intervention. In addition to the WellWorks activities described here, the worksites generally offered additional health and safety training programs required for their workers.

For nutrition, individual skill-building groups were offered in lunchtime discussion sessions on how to purchase and prepare foods lower in fat and higher in fiber. For smokers, project staff facilitated American Lung Association and American Cancer Society smoking cessation groups, and in some worksites, hypnotherapy classes were provided to promote smoking cessation. Because the overall Working Well Trial targeted smoking and nutrition as core risk factors, this preliminary test of an integrated health promotion/health protection intervention provided a stronger emphasis on health promotion than on health protection interventions.

RESEARCH METHOD

The WellWorks study used a randomized, matched-pair research design, with the worksite as the unit of assignment and analysis.[11,14] Because the focus of these analyses is program participation, only data from the 12 intervention sites were included in the analyses. By analyzing data only from the intervention sites, we are able to assess participation in the standardized intervention program offered across 12 worksites. Thus we are able to exclude lack of program availability as a reason for nonparticipation.

Data Collection

At the conclusion of the 2-year intervention, a follow-up survey was immediately administered at the 12 intervention sites, which employed approximately 6,450 workers. The survey was administered to a random sample of workers in the 7 larger sites, and to a census of all workers in the 5 smaller sites. Employees eligible for the survey included those permanent employees working at least 50% of the time. The self-administered survey was distributed to a total of 4,465 employees in the 12 worksites (range = 192-528), using internal worksite distribution channels. Three follow-up reminders were sent to nonrespondents, and incentives were provided for participation in the survey. The overall response rate was 62% (N = 2767; response rate range across worksites = 43%-88%). After excluding out-of-range data, 2,578 cases were included in the analyses.*

Measures

These analyses focus on individual employee participation in the WellWorks program. Participation in the WellWorks program was measured by self-report in the final survey. Program participation in the last 2 years was assessed based on the question, "Have you participated in the following activities in your worksite?" Response options for smoking cessation activities included quit-smoking contests, stop-smoking classes or presentations, and smoking quizzes or assessments (e.g., carbon monoxide testing). Participation in smoking cessation interventions was measured among current smokers and prior smokers who had quit within the last 2 years. Response options for nutrition included nutrition or healthy-eating contests, healthy-eating classes or presentations, healthy-eating quizzes or assessments, and food demonstrations or taste tests about healthy eating. Response options for occupational exposures included classes or presentations about reducing exposure to harmful substances. For the purposes of this analysis, we focused on participation in educational activities rather than use of educational materials such as videos or booklets, thus providing an assessment of participation requiring more investment and active behavior on the part of the individual worker. Participation was coded as "yes" (1) if the respondent reported participating in at least one of the activities for that risk factor.

Perceived employer changes to reduce exposures was measured by the responses to the question, "Has your employer made any changes in the last 2 years that might increase or decrease your exposure to harmful substances?" Analyses were conducted comparing those agreeing and disagreeing that changes were made to *reduce* exposures.

In addition, demographic characteristics of the respondents are presented using data from the final survey, including age, sex, education, race, and job status. Craftspersons and laborers included skilled or craft workers, machine operators, and manual laborers; clerical workers included clerical, office, and sales workers; professionals and managers were those who performed professional, managerial, and administrative work; scientific/technical work included such jobs as computer programmer and lab technician; and service work comprised such positions as firefighter, custodian, and cafeteria worker. Responses that included multiple choices were coded as missing. We also reported smoking status and self-reported exposure to occupational hazards at follow-up.

* For accurate comparisons with other analyses of these data, we excluded cases with out-of-range data for the primary nutrition outcomes (n = 189 cases).

Table 1. Participation in WellWorks Intervention by Job Status

Intervention Participation	Craftspersons/Laborers		Other		Total	
	n	%	*n*	%	*n*	%
Nutrition (n = 2,578)	359	39.6	865	50.8	1,224	49.0
Occupational exposure (n = 2,507)	352	42.2	576	36.1	928	39.4
Smoking (smokers and recent quitters only; n = 699)	78	27.6	144	37.3	222	34.2

NOTE: Percentages are calculated as the mean of worksite-specific percentages to adjust for the clustering of workers in worksites.

Data Analysis

Participation across intervention activities (i.e., nutrition, smoking cessation, exposure) was evaluated by cross-tabulation, stratified by worksite.[35] The associations between participation and other factors, including job status, sex, and perceived employer changes, were assessed by cross-tabulation, stratified by worksite. Homogeneity of the association across worksites was tested by the Breslow-Day test. The hypothesis was not rejected for any of the intervention activities, and therefore the overall association was estimated using an odds ratio, controlling for worksite. The overall association was tested by the Cochran-Mantel-Haenszel chi-square test. Finally, multiple logistic regression analysis was used to compute multivariate odds ratios for participation in each of the two health promotion activities with participation in exposure activities, controlling for job category, gender, perceived employer changes, and worksite. Worksite was incorporated in the logistic model by dummy variable coding.

RESULTS

Characteristics of the Sample

About half (51%) of the respondents were between 35 and 50 years of age; 27% were under 35 and 23% were over 50 years of age. Nearly 70% were men. About one-third (34%) of the respondents had no more than a high school education and an additional third had at least a bachelor's degree. One-third (33%) worked as craftspersons and laborers. Twenty percent reported that they were current smokers, and an additional 9% reported having quit smoking during the last 2 years. Over 96% of the sample was white. In addition, 31% of the respondents reported that they were exposed to harmful substances on their jobs.

Job status was related to education level. Nearly two-thirds (63%) of craftspersons and laborers had a high school education or less, compared with 30% of service workers, 34% of clerical/sales workers, 20% of scientific and technical workers, and 4% of professionals and managers.

Table 2. Pooled Odds Ratios and 95% Confidence Intervals for the Associations of Participation in Each Type of Activity, Controlling for Worksite

Activities	*n*	Odds Ratio	95% C.I.
Nutrition/exposure	2,507	1.49	(1.25, 1.76)
Nutrition/smoking[a]	699	4.96	(3.39, 7.24)
Smoking[a]/exposure	681	1.16	(0.82, 1.65)

a. Among workers who currently smoke or quit within the last 2 years.

Table 3. Pooled Odds Ratios and 95% Confidence Intervals for the Association of Participation in Each Type of Activity With Perceived Employer Changes to Reduce Exposure, Controlling for Worksite

Activities	*n*	Odds Ratio	95% C.I.
Nutrition	2,185	1.46	(1.21, 1.76)
Occupational exposure[a]	2,160	3.27	(2.64, 4.05)
Smoking	596	1.68	(1.13, 2.48)

NOTE: Participation in activities coded "yes" or "no"; perceived employer changes coded "yes" or "no/don't know."

a. For occupational exposure activities, the test for the homogeneity of odds ratios was rejected, meaning that there is a significant difference in the association across worksites. In all but two worksites, workers who perceived management to have made changes to reduce exposure to harmful substances in the workplace were significantly more likely to participate.

Program Participation and Job Category

Participation in program activities overall was quite high, ranging from 34% overall for smoking cessation to 49% overall for nutrition (see Table 1). Craftspersons and laborers were less likely than other workers to participate in nutrition activities and smoking cessation activities, but were more likely to participate in activities about occupational exposures.

Associations of Participation Across Risk Factor Areas

There was a strong association between participation in nutrition activities and participation in activities related to the other two risk factors (see Table 2). Workers participating in activities about occupational exposures were 1½ times as likely to participate in nutrition activities as workers not participating in exposure-related activities. Among smokers and recent quitters, workers participating in smoking control activities were nearly five times as likely to participate in nutrition activities as workers not participating in smoking control activities. The association between participation in exposure-related activities and smoking control activities was not statistically significant.

Table 4. Multivariate Odds Ratios and 95% Confidence Intervals for the Associations With Participation in Nutrition Activities, Controlling for Worksite ($N = 2,151$)

Independent Variables	Multivariate Odds Ratio	95% C.I.
Craftspersons/laborers	0.66	(0.53, 0.81)
Female	2.23	(1.80, 2.75)
Participation in exposure activities	1.58	(1.28, 1.94)
Perceived employer changes	1.54	(1.26, 1.88)

Table 5. Multivariate Odds Ratios and 95% Confidence Intervals for the Associations With Participation in Smoking Activities Among Smokers and Recent Quitters, Controlling for Worksite ($N = 588$)

Independent Variables	Multivariate Odds Ratio	95% C.I.
Craftspersons/laborers	0.70	(0.45, 1.05)
Female	2.78	(1.81, 4.26)
Participation in exposure activities	1.31	(0.86, 2.00)
Perceived employer changes	1.92	(1.28, 2.90)

NOTE: Analyses conducted for smokers and recent quitters (within the last 2 years) only.

Program Participation and Perceived Employer Changes to Reduce Exposures

Participation in any type of intervention—related to nutrition, occupational exposure, or smoking cessation—was significantly associated with perceived employer changes to reduce exposures to occupational hazards (Table 3).

Multivariate Analyses

We examined correlates of participation in nutrition-related (Table 4) and smoking control (Table 5) activities, and included in the logistic regression model job category (craftspersons and laborers vs. all others), sex (female vs. male), participation in exposure-related activities (yes vs. no), and perceived employer changes to reduce exposures (yes vs. no/don't know). Education was not included in the model due to the strong association between job category and education. The tables present the multivariate odds ratios for the association of each variable with participation, when other variables in the model were controlled.

As shown in Table 4, craftspersons and laborers were less likely than other workers to participate in nutrition-related activities, and men were less likely to participate than women. Even controlling for these variables, workers who participated in activities targeting occupational exposures and who perceived their employers to have made changes to reduce occupational hazards were more likely to have participated in nutrition activities. No two-way interaction effects were statistically significant.

Table 5 presents the multivariate odds ratios for the associations of these independent variables with participation in smoking control activities among smokers and persons

who have quit smoking within the last 2 years. Again, we find that craftspersons and laborers and men were less likely to participate in smoking control activities, compared to workers in other jobs and women, respectively. Controlling for these variables, workers who perceived their employers to have made changes to reduce occupational exposures were more likely to participate in smoking-related activities than workers reporting that such changes were not made. Workers who participated in exposure-related activities were more likely to have participated in smoking control activities than workers not participating in exposure-related activities, but this association was not statistically significant. No statistically significant two-way interactions were observed.

DISCUSSION

The high risk faced by blue-collar workers—as exemplified by their high levels of exposure to occupational hazards and high smoking rates—underlines the need for effective worksite health programs that intervene with this group. The analyses presented here explored the relationships between participation in health protection and health promotion activities, and between workers' perceptions of management changes to reduce job risks and participation in health promotion programs, controlling for job status. The results point to the potential importance of integrating health protection and health promotion as a strategy in the delivery of public health programs for blue-collar workers.

As reported by previous investigators, these results indicate that blue-collar workers were less likely to participate in health promotion activities than white-collar workers.[20-24] Although participation in intervention activities does not by itself constitute behavior change, it is an important preliminary step on a continuum from awareness to participation to behavior change to ultimate risk reduction.[19]

These data also shed light on potential ways to enhance the participation of these workers in health promotion programs. Controlling for job status and gender, we found that workers who participated in exposure-related activities were significantly more likely to have participated in nutrition education activities than workers who did not participate in exposure-related activities. Although the result was not statistically significant, a similar trend was found in the relationship between participation in exposure-related and smoking control activities. Based on these findings, it seems plausible that offering programs to reduce exposures to occupational hazards may actually stimulate blue-collar workers' participation in health promotion activities, although we cannot be sure of the direction of these effects.

In addition, workers who reported that their employers had made changes to reduce exposures were significantly more likely to have participated in both smoking control and nutrition activities, compared to workers not reporting that management had made such changes. The data also demonstrated an association between participation in exposure-related activities and perceptions of employer changes. Workers who perceive that their employers are willing to make changes to reduce occupational exposures may be more likely to participate in both health protection *and* health promotion interventions. When workers perceive that management is introducing environmental changes to reduce worker exposures, measures under management control, workers themselves may be more willing to reduce health risks such as smoking and unhealthy eating, factors within the worker's control.[17] Workers' perceptions of management changes may be an important impetus to engage workers in the process of health-promoting changes. Given that these data are cross-sectional and correlational, a further interpretation of the results may be

that participants in health promotion programs are more likely than nonparticipants to perceive or be aware of changes employers make to reduce occupational exposures.

The high participation rates reported in this program suggest that the integration of health protection in this health promotion program is related to increased participation rates. Participation rates in other smoking cessation programs have been reported as low as 2%-4% and as high as 15%.[36] Here, we found that among smokers and recent quitters, 28% of craftspersons and laborers and 37% of other workers reported participating in smoking control activities. Worksite-wide participation rates for nutrition programs are not readily available in the literature, since few interventions have targeted the entire workforce.[37] One intervention study focusing only on nutrition found that in the intervention group, 17% of workers reported participating in nutrition-related classes and 29% reported participating in taste tests.[38] In this study, we found that 40% of craftspersons and laborers and over half of other workers reported participating in nutrition activities. The implications of these findings for intervention practice are bolstered by the consistency of the results: significant relationships were observed between perceived changes by employers to reduce occupational hazards and participation in both smoking and dietary habits, and between participation in exposure-related activities and nutrition education activities. In addition, although the association between exposure-related activities and smoking control activities was not statistically significant, the trend was in the expected direction.

As noted, because these data are cross-sectional and correlational in nature, we must be cautious in interpreting the direction of these effects. Although these results indicate that health promotion program participation is related to participation in programs to reduce occupational hazards and to employer changes to reduce hazards, information is not available on the causal direction of this relationship. Program participation actually may enhance employees' perceptions of employer changes; workers participating in health-related activities may be more aware of employer changes or more favorably impressed by employer actions than nonparticipating workers. In addition, some workers may be more inclined to participate in any type of health program, a factor that may contribute to the strong correlations among types of program participation. Nonetheless, these data indicate that workers do not compartmentalize their participation in health promotion and health protection efforts, suggesting that integrated health promotion/health protection efforts are warranted. Further research is needed to explore this hypothesis further. For example, participation in health promotion programs might be assessed in a study that randomly assigned worksites to receive health promotion only or health promotion *plus* health protection programs.

Additional caveats should be noted in the interpretation of these data. Analyses are based on self-reported data. In addition, the response rate to this survey leaves open the possibility of response bias; participants may have been more likely to respond to the survey than nonparticipants. The self-selection of the worksites limits the study's generalizability, underlining the need for confirmation of these results in further studies. Finally, as noted above, because the overall Working Well intervention protocol framed this intervention, smoking and nutrition received a stronger emphasis than health protection issues; future studies are needed to assess the impact of a worksite intervention fully integrating health promotion and health protection.

These findings do, however, point to the potential importance of integrating health promotion and health protection in worksite efforts aimed at reducing disease risks for workers. In addition, these results suggest important opportunities for practitioners engaged in worksite health programs and for researchers conducting worksite health education

and occupational health intervention studies. More complete studies of the integration of health promotion and health protection are needed, particularly given that this intervention did not give equal weight to health promotion and health protection. Joint training for health and safety specialists and health educators planning to base their careers in worksites is recommended as a means of expanding the vision of worker health. Health promotion providers have frequently ignored the concerns imposed by the worksite environment, finding it more feasible to focus exclusively on health behaviors.[17,18] Similarly, health protection providers often are reluctant to address health behaviors as part of their efforts, concerned that it may dilute their efforts or deplete their resources.[39] Interdisciplinary efforts that build on the disparate educational preparation and work experiences of each discipline are needed to reach the goal of worker health shared by health protection and health promotion. Collaboration across these two disciplines may generate more effective strategies for reaching blue-collar workers, for whom current health promotion efforts are least effective.

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Effect of Organization-Level Variables on Differential Employee Participation in 10 Federal Worksite Health Promotion Programs

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Guided by a conceptual model, the authors used both qualitative data (e.g., individual interviews, focus groups) and quantitative data from an employee survey (N = 3,388) in 10 federal agencies to investigate whether organization context and implementation process affected participation in worksite health promotion and disease prevention (HPDP) activities among demographic subgroups. Overall, employees on average participated in fewer than two agency-supported health-related activities per year (17% in fitness, 40% in health risk assessment activities). Employees participated more where coworkers endorsed such programs. Minority employees and employees in lower level positions were more likely to participate in fitness activities when organizations had a more comprehensive program structure, engaged in more marketing strategies, gave time off to employees to participate, or had on-site facilities. Management support for the program was related to participation by employees who were male, white, and had upper level positions. The data supported the proposed model; also confirmed was two predicted relationships between model constructs, which provided a better understanding of differential participation by employee groups.

INTRODUCTION

The worksite can be an effective location for promoting healthy lifestyle behaviors among employees.[1,2,3] Aside from simply reaching the large employed population, worksite health promotion and disease prevention (HPDP) programs have the ability to help foster an organization culture that reinforces healthy lifestyle behaviors, thus potentially reducing health disparities among employed persons.[4-8] When done well, worksite HPDP programs can screen, counsel, and follow employees in a timely and cost-efficient manner. However, not all worksite HPDP efforts are equally effective in

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encouraging employee participation or in improving the health of the workforce. Despite expansion in the number and focus of HPDP programs, participation rates remain low, particularly among individuals at greatest health risk.[9-15]

Because participation rates largely determine the impact of worksite HPDP programs, programs that appeal primarily to white, middle-class, highly educated employees will miss an opportunity to decrease the health gap across employees. Understanding the reasons for limited participation by employees may lead to more effective programs and provide improved cost-benefit ratios. The purpose of this study is to determine whether worksites are missing the opportunity to reach those with the greatest health needs, thereby decreasing the health-related disparity among employees. Data from 10 federal worksite health promotion programs allowed us to describe the rates and patterns of participation among demographic subgroups across various HPDP activities (e.g., health risk assessment, fitness). This study specifically investigates whether organization context and implementation process are related to the rate and pattern of employee participation by subgroup.

CONCEPTUAL MODEL

Ottoson and Green[16] have posited that four factors (policy, implementing organization, political milieu, and environment) influence implementation process and program outcomes. Building on these ideas, Gottlieb et al.[17] suggest that HPDP program implementation and its subsequent outcomes are the result of an interaction between some intervention (i.e., concept) and the context within which that intervention is introduced. Gottlieb et al. found support for their model in a study of the implementation of a restrictive smoking policy in a large state agency with 400 decentralized worksites. They concluded that their Innovation Implementation Model was appropriate for analyzing other worksite HPDP programs and discussed the need for comparative studies to extend our understanding of the relationships among concept, context, and process variables.

Figure 1 outlines the model guiding this study. We explore similar factors to those included in Gottlieb et al.'s[17] model, but apply our model to a more diverse set of HPDP programs. The model in Figure 1 indicates that employee participation is dependent on the organization context in which it is applied and the program's implementation process. In this model the dimensions listed under organization context and implementation process are defined as independent variables. Rates and patterns of employee participation, the study's dependent variables, are outcomes of HPDP programs. At the organization level, "better" employee participation is defined as equally high participation across all employee subgroups (e.g., race, job class). The conceptual definitions of the three constructs in the model are specified in Figure 1; Table 1 contains the conceptual definitions of the dimensions.

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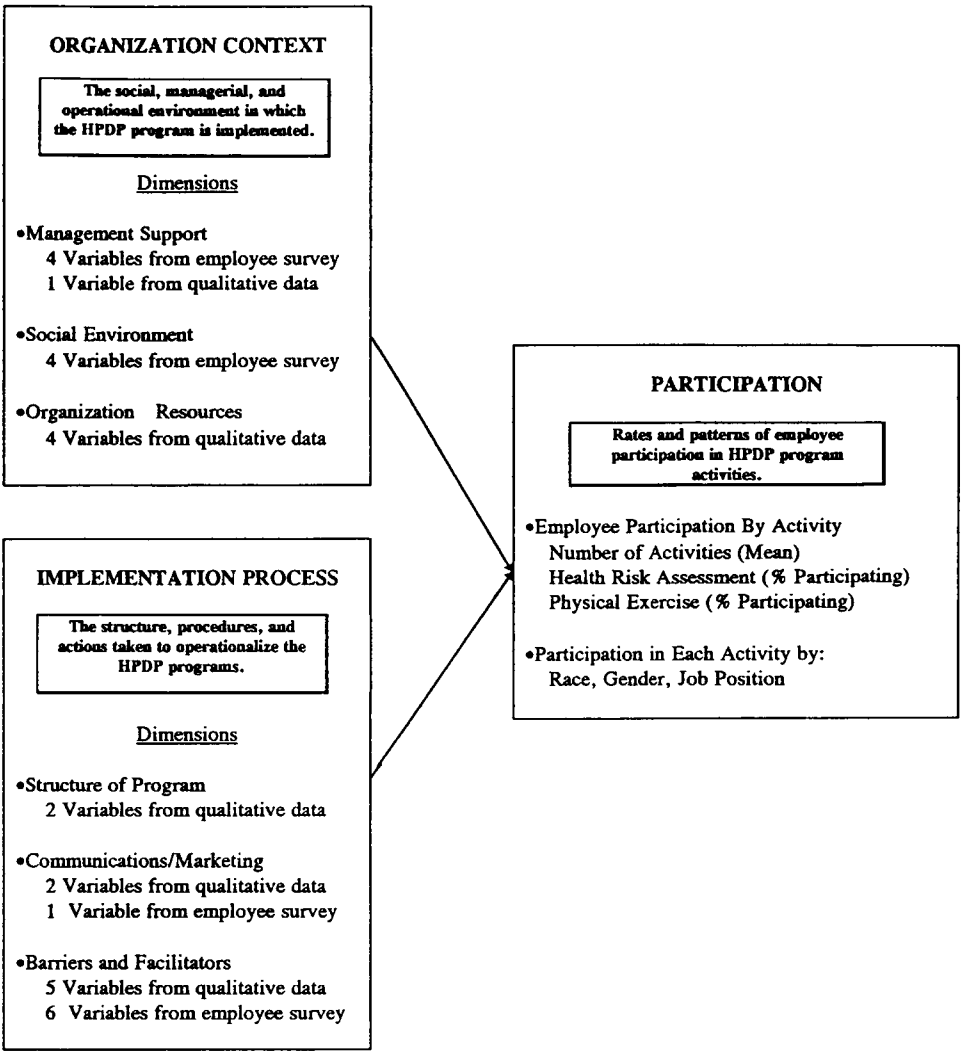

Figure 1. Conceptual model of relationships among constructs investigated in federal worksite health promotion programs.

Organization context refers to the social, managerial, and operational environment in which a program is administered. Three dimensions represent organization context in this study: management support, normative influences arising from the social environment, and organization resources for HPDP programs. Limited support from managers, coworkers, and the organization, for example, is expected to reduce program participation.

Implementation refers to the processes used to establish a particular program or translate program ideas into action. Three implementation action steps are operationalized in this research: the structure of the program, communication and marketing strategies, and participation barriers and facilitators. Inadequate implementation is one reason worksite HPDP programs may be unsuccessful in encouraging widespread employee participation.[18,19,20]

Table 1. Conceptual Definitions of Model Dimensions by Construct

Organization context	
Management support	Degree of decision makers' support for the HPDP program as indicated by managers' participation in agency-supported activities, beliefs about the program, percentage of employees who believe their manager supports their participation, and stated support for program
Social environment	The extent to which employees indicate that their coworkers support their participation in HPDP activities, normative influence supporting healthy behaviors, and employee attitudes and beliefs about the HPDP program
Organization resources	Presence of supportive policies and instrumental support that the agency contributes to the HPDP program, for example, facilities, salary, permanent budget, and release time for participation
Implementation process	
Structure of program	Content and intensity of activities offered by HPDP programs
Communication/marketing	Extent of the marketing steps taken to promote the program
Barriers and facilitators	Extent to which barriers and facilitators to program participation exist, quality of the staff, and presence of program evaluation processes
Employee participation	
Participation by activity	Proportion of employees participating in agency-supported fitness and health risk assessment activities; mean of seven HPDP activities in which employees participate
Participation patterns	Extent to which all employees and subgroups (i.e., gender, race, job level) participate in agency-supported health-related activities

Program outcomes refer to the impact of the program. Employee participation rates and patterns are used in this study as indicators of HPDP programs' effectiveness in encouraging participation among all employees. Participation rates among selected groups (e.g., race, job level) of employees will be used to estimate the extent to which the programs have been successful in encouraging participation among all employees. Participation, in turn, is acknowledged to be a necessary, although not sufficient, precursor of positive, health-related benefits.

Method

Data used in this study were obtained from case study reports, completed in 1991, about HPDP activities offered by 10 federal agencies. The present research used a case study approach[21] with a cross-sectional research design. Data reviewed for this study included each agency's case study document, HPDP program materials, previsit and on-site surveys and summaries, interviews with program administrators, interviews with middle and upper level managers, focus groups with employees, and a cross-sectional survey of employees. The survey was mailed to employees. It asked about their participation in, and attitudes about, HPDP program activities for the previous year. At some sites we canvased the entire agency staff. When this was not possible we selected a systematic random sample of employees to receive the survey.[22]

Operationalization of Participation Variables

The dependent variables for this study were obtained from the employee survey. The seven health-related activities for which participation was investigated were the following: fitness, nutrition and weight control, health risk assessment (HRA), health and disease risk information, medical care services, personal safety and first aid, and stress control. Respondents indicated whether or not and how (e.g., agency-supported, on-own) they participated in any of the seven health-related activities in the past year. Employee participation at the agency level was measured in three ways: (1) average number of agency-supported activities (range = 1-7) employees participated in, (2) percentage of employees participating in agency-supported physical fitness and exercise activities, and (3) percentage of employees participating in agency-supported HRA activities.

The average number of health-related activities participated in by employees was used as an indicator of the breadth of employee participation in HPDP activities supported by an agency. This variable was calculated by summing the number of agency-supported activities in which an employee participated and then calculating an agency average. For the two participation variables specific to an activity, we calculated the proportion of respondents indicating participation in agency-supported physical fitness and HRA programs. These two activities were selected for separate analyses because fitness and health risk assessment activities are commonly offered as part of worksite HPDP programs and these activities were offered by each of the agencies in this study.

Operationalization of Participation Variables by Demographic Subgroups

A total of six overlapping employee subgroups were created using respondent demographic characteristics. Respondents were classified into three dichotomous demographic categories for gender, race, and job level (Table 2). These demographic categories were created to investigate participation patterns across subgroups of employees who could be either at "higher risk" for chronic disease (i.e., lower job level), relatively disadvantaged (i.e., minorities, lower job level), or underserved by worksite HPDP programs (i.e., women, minorities).[23,24] We used the categories to determine if relationships between subgroup participation and agency dimension scores differed from those for the total sample.[25]

Race was dichotomized into two categories: white and other. The "other" category included those who indicated they were Asian, African American, Hispanic, Native American, or other. Respondents classified as "high level" positions were officers (e.g., special agents), administrators with General Schedule (GS) levels greater than 13, and managers, professionals, and technicians with GS levels greater than 6. Respondents classified as "low level" positions were administrators with GS levels less than or equal to 13, technicians with GS levels less than or equal to 6, clerks (secretaries), and those indicating wage grade positions (labor).

Employee Participation by Subgroup

The three measures of participation were calculated for the six employee subgroup categories. A separate agency value (i.e., mean number of activities, percentage of

Table 2. Three Dichotomous Demographic Categories of Respondents ($N = 3,388$)

Demographic Characteristic	Number in Total Sample	Percentage
Gender ($N = 3,338$)[a]		
Male	1,681	50.4
Female	1,657	49.6
Race ($N = 3,257$)[b]		
White	2,348	72.1
Other[c]	909	27.9
Job level ($N = 3,331$)[d]		
Lower level	1,029	30.9
Higher level	2,302	69.1

a. Missing gender for 50 (1.5% of total).
b. Missing race for 131 (3.9% of total).
c. African American, Asian, Hispanic, Native American, other.
d. Missing job level for 57 (1.7% of total).

participation) for each of the three participation measures (i.e., mean number of activities, fitness, health risk assessment) was calculated for these six employee subgroups.

Operationalization of the Study's Independent Variables

Fourteen independent variables, derived from 10 qualitative data sources (e.g., case study, interview summaries), and 14 variables, derived from the employee survey, measure dimensions outlined in the conceptual model (Figure 1) guiding this study. We used a three-step process to code the qualitative data collected during the case study project to assess the hypothesized relationships outlined in Figure 1.

Preparation and Coding of Qualitative Data

The qualitative data was initially reviewed to identify what information was related to each dimension identified in the conceptual model. Qualitative data were sorted by agency (i.e., site), with each page coded for data source and page of document. Each of the 1,381 data pages was read by the first author, and passages were marked with relevant dimension codes. The conceptual definitions for each dimension (Table 1) were used as a coding guide. Information in a single paragraph was found to be related to as many as four of the six dimensions. A total of 2,063 passages were coded. During a second reading of the original data, again by the first author, only 257 passages were added or deleted, indicating high intrareader agreement (87.5%). These changes contributed to the consistency of information coded for each dimension across agencies.

Coded passages were copied, manually cut out, and sorted by dimension and agency. Coded passages were organized, by agency, into dimension summary pages. The number of pages varied by dimension, ranging from 14 to 74, for a total of 383 summary pages. Complete paragraphs were retained for contextual clarification. The second step involved two individuals separately reviewing all dimension-level information and independently identifying potential variables that could be measured for each dimension. Consensus

was reached about which variables would yield the most valid conceptual definition of the dimensions. We prepared a code book containing variable definitions and scale anchor descriptions. For the third step, two independent raters used the guidelines to code the qualitative data. The kappa statistic was calculated to measure the extent of agreement beyond chance between the two raters for the agency-level variables derived from the qualitative data.[26,27] Interrater reliability for the study variables was acceptable (.40 to .75) to excellent (>.75) for all but two of the derived study variables (i.e., separate budget, marketing to higher risk groups). However, once coding decisions were refined, consensus was reached between the two coders on all 14 agency-level variables. These steps for producing reliable variables from qualitative data are consistent with recommendations in the literature.[28,29,30]

Management Support

We used five indicators of management support (Appendix A). One dichotomous variable specified the presence of upper level management support for a HPDP program. This variable was derived from the qualitative data. The remaining four variables were derived from the employee survey. Managers responded to the employee survey on a 5-point scale (1 = *strongly disagree*, 5 = *strongly agree*) concerning two statements. These statements specified that worksite HPDP programs "should be offered" and that employees "should be allowed time off to participate" in them. For the third variable, employees used the same 5-point scale to indicate agreement or disagreement with the statement, "HPDP program activities are not supported by my manager." This item was reverse coded and indicated the proportion of employees who perceived their managers to be supportive of employee participation in HPDP activities. Finally, the proportion of managers responding to the employee survey who reported their *own* participation in agency-supported HPDP activities measured the extent to which managers in an agency are role models for participation in HPDP activities. This fourth variable was operationalized by the mean number of agency-supported activities in which managers indicated they participated.

Social Environment

Indicators for this dimension were derived from the employee survey (Appendix A). This dimension refers to normative support for worksite HPDP programs. Using the same 5-point scale (1 = *strongly disagree*, 5 = *strongly agree*), employees were asked to estimate the social environment with the following four items: "HPDP activities discussed among coworkers," "others make me feel bad if I don't participate," "program should be offered," and "the HPDP program generates enthusiasm for healthy behavior." These variables were operationalized by the proportion agreeing with the statements.

Organization Resources

The qualitative data generated four variables to measure this dimension (Appendix A). These dichotomous variables indicated the presence or absence of a resource: a separate

budget for HPDP program, administrative leave time for employees to attend some HPDP activities, a variety of staff to guide the program activities, and on-site fitness facilities.

Structure of Program

Variables to measure this dimension were derived from the qualitative data (Appendix B). The first variable indicates the number of activities offered by each agency during the last year and was coded on a 3-point scale (1 = *less than or equal to 6 activities*, 2 = *7 to 12 activities*, 3 = *13 or more activities*). The second indicator for this dimension involved rating the HPDP program structures at each agency using a modified version of the Wellness Councils of American (WELCOA) standards for worksite HPDP programs.[31] The following criteria were used to rate the agencies in this study: 1 = at least two awareness and three educational programs were provided, 2 = at least three educational and two behavior change programs were provided, and 3 = at least three educational and four behavior change programs were provided.

Communication/Marketing

This dimension was operationalized by two dichotomous variables derived from the qualitative data and one variable from the employee survey (Appendix B). The first variable indicated whether targeted marketing strategies were used to increase participation among high-risk or disadvantaged employees. The second variable indicated whether systematic actions were taken to provide tangible or recognition incentives to encourage employee participation. The third indicator was the extent to which the agency promoted the HPDP program, operationalized as the average number of ways employees indicated they were informed about agency-supported health promotion activities. Employees could check off up to seven categories. After summing those checked by individuals within an agency, the average for the agency across employees was calculated.

Participation Barriers and Facilitators

We used both qualitative and employee survey data to derive 11 indicators of participation barriers and facilitators (Appendix B). The five variables derived from the qualitative data included four related to needs assessment and process evaluation actions. The first variable was coded as a 0 if a needs assessment was not completed, coded 1 if one needs assessment was completed, and coded 2 if more than one needs assessment had been completed. The next two variables indicated whether the agency conducted overall program evaluations or individual activity evaluations. The fourth variable assessed whether there was evidence that the agency used information collected from a needs assessment or evaluation to improve their programs. A fifth variable, also derived from the qualitative data, indicated whether the program coordinator was consistently identified as important to program success or effectiveness during interviews with agency personnel. Indicators of the barriers and facilitators dimension were also obtained from six employee survey items. Four items obtained from the survey indicated whether the HPDP programs were conveniently located, offered at convenient times, boring, or

expensive. Two other items indicated whether the programs required too much time or provided enough individual instruction. The last four items were labeled "barriers to participation" and were reverse coded so that the dimension reflected a positive score (i.e., facilitation of employee participation).

Dimension Scores

A composite agency score was calculated for each of the six dimensions listed in the conceptual model (Appendixes A and B). To calculate the dimension score we first standardized each variable to equalize the measurement of scales (i.e., subtracted the mean across agencies from the agency value and divided this value by the standard deviation). The standardized variables, listed for each dimension in Appendixes A and B, were summed to form the agency-level dimension score used in the analyses. Strategies other than equal weighting were considered for summing the variables to form the dimensions. However, in the absence of specific empirical information suggesting specific alternatives, the use of equal weighting was assumed appropriate.

Data Analysis Strategy

Agency Attributes

We derived agency-level variables identifying the percentage of respondents for the three employee demographic subgroups (e.g., percentage male, percentage white, percentage lower level job). The relationships between participation and agency demographics (e.g., percentage male, white, lower level jobs) and two agency characteristics (i.e., size and years the health promotion program was in place) were assessed with Pearson's product-moment correlation coefficients.

Assessment of Relationships Between Study Dimensions

We investigated the relationships between organization context and implementation process and our outcome measures of employee participation by assessing the associations between the six dimensions and the three participation measures (i.e., seven health-related activities, fitness activities, health risk assessment). These relationships were also assessed for six employee subgroups (i.e., men, women, white, other, higher job level, lower job level). An a priori effect size of .40 for the Pearson product-moment correlation coefficients was identified as the level of association that indicated tentative support for a relationship between a dimension and employee participation.[30,32,33]

Given the small sample size ($N = 10$), it was not possible to control for potential confounding variables through the use of a semipartial correlation coefficient. However, it was possible to investigate the differences in the correlations between dimensions and employee participation variables calculated separately for subgroups of employees.[30] This strategy simultaneously addresses confounding and allows analysis of heterogeneity in the impact of worksite constructs on participation. Pearson's product-moment correlation coefficients were calculated between the dimension scores and 18 newly created agency-level participation measures (i.e., six subgroups by three participation measures).

Agency-level predictor variables (dimension scores) were used both for the total sample and the subgroup analyses.

Correlation tables for each participation measure (e.g., fitness, health risk assessment) were examined to determine if there were differences between the correlations calculated for the total sample and those conditional correlations that used subgroup data.[34] If the subgroup correlations were similar to each other, but lower (by at least .25) than correlations for the total sample, then the correlation for the total group was considered biased by differences in the employee composition among the agencies (i.e., confounding).[30,34] If the subgroup correlations were similar to each other and similar to the total group, then the primary relationship of interest was considered robust across that subgroup.[30] If, however, the subgroup correlations were different from each other (by at least .25), then the relationship was not considered general but subgroup specific (i.e., interaction).[34]

Study Sample Description

Four types of federal agencies were included in the case study project: administrative, medical center or clinic, scientific research, and weapons research. This study focused on issues relevant to, and programs located in, moderate to large institutions with the number of employees in each agency ranging from 300 to 8,000 (the average was approximately 2,500). We obtained a 59% response rate to the cross-sectional mailed employee survey. Response rates by agency ranged from 49% to 71%. These response rates did not appear to differ by race or gender. Of the 3,403 employees who responded to the mailed survey, 15 were contract employees and therefore excluded from the analyses. The resulting 3,388 respondents were evenly distributed by gender. The racial mix included 7% Asian, 8% African American, and 8% Hispanic. The average age of the respondents was 41.8 (10.5). Most of the respondents were highly educated, with 25% having achieved advanced degrees.

RESULTS

On average in one year, employees participated in fewer than two agency-supported activities (Table 3). The average percentage of employees participating in agency-supported fitness activities was 17%, with a range of 5% to 27% across the 10 agencies. The average percentage of employees participating in agency-supported health risk assessment activities was 40%, with a range of 17% to 72% across the 10 agencies. In 2 agencies participation in agency-supported health risk assessment activities was greater than 60%.

Participation rates for overall and by employee subgroups by agency are listed in Table 3. Considerable variability exists within agencies by subgroup for fitness and health risk assessment activities. Interagency differences are also present for participation in fitness and health risk assessment activities.

Relationship Between Implementation Process and Employee Participation

Greater employee participation in fitness activities was achieved in organizations that did a better job of reducing barriers to participation ($r = .83$) or marketing their program

Table 3. Participation Variables by Employee Subgroup for Each Agency

Employee Group	Participation Value for Each Agency									
	1	2	3	4	5	6	7	8	9	10
Participation in seven health-related activities (mean number of activities)										
Total	1.9	1.9	1.3	1.1	1.9	2.1	1.9	1.9	1.8	1.6
Men	1.7	1.9	1.4	1.1	1.9	2.3	1.8	2.0	1.8	1.8
Women	2.2	2.0	1.3	1.2	1.9	2.0	2.1	1.8	1.9	1.5
White	1.7	1.9	1.3	1.1	1.9	2.2	1.9	2.1	1.8	1.6
Other	2.2	2.0	1.4	1.3	2.0	1.9	2.5	1.8	1.9	1.7
High-level job	1.8	2.0	1.3	1.1	1.9	2.3	1.8	2.2	1.9	1.7
Low-level job	2.1	1.7	1.4	1.5	1.8	1.7	2.2	1.6	1.7	1.5
Participation in fitness activities (proportion of employees participating)										
Total	25	27	6.7	19	18	27	16	6.8	19	4.5
Men	16	22	5.6	18	18	29	11	12	11	7.3
Women	36	31	7.2	20	19	26	27	4.2	25	2.5
White	18	28	6.4	19	19	29	17	9.6	20	5.6
Other	36	23	7.5	19	20	19	17	4.7	18	0.0
High-level job	23	27	7.4	19	20	32	16	7.4	22	5.5
Low-level job	30	27	4.4	19	7.9	18	17	5.6	16	3.4
Participation in health risk assessment (proportion of employees participating)										
Total	42	42	34	34	72	64	53	25	17	19
Men	41	49	38	34	76	69	54	32	24	24
Women	45	35	31	33	66	59	51	22	12	16
White	41	43	34	32	71	66	53	28	14	19
Other	46	36	36	42	83	60	55	23	21	20
High-level job	43	46	33	34	74	70	52	33	18	18
Low-level job	42	26	37	36	63	50	55	18	16	21

(r = .60) (Table 4). Reducing barriers to participation also was associated with greater employee participation in seven agency-supported activities (r = .55) and in health risk assessment activities (r = .57). We therefore found support for the hypothesized relationship between implementation process and employee participation, but only for fitness activities.

We found differences when we examined the relationship between implementation process and employee participation within six employee subgroups. With respect to the seven health-related activities, all aspects of the implementation process (i.e., more comprehensive structure, increased communication and marketing, and reduced barriers) had a far stronger impact on women, ethnic minorities, and those in lower level jobs, as compared with men, whites, and those in higher level jobs (Table 4). Similar disparities were seen for participation in fitness, with the exception being that differences by job level were smaller, and barriers influenced participation for all subgroups. In contrast, the impact of implementation process on participation in health risk assessment activities did not differ much by employee subgroup.

Table 4. Assessment of Relationship Between Implementation Process and Employee Participation ($N = 10$)

	Total	Gender		Race		Job Level	
		Men	Women	White	Other	Upper	Lower
Relationship Assessed	*r*	*r*	*r*	*r*	*r*	*r*	*r*
Participation in seven health-related activities							
Structure of program	–.03	–.35	.25	–.26	.37	–.27	**.56**
Communication/marketing	.02	–.33	.34	–.19	**.45**	–.23	**.72**
Barriers and facilitators	**.55**	.21	**.78**	.33	**.75**	.30	**.82**
Participation in fitness activities							
Structure of program	.35	–.05	**.56**	.21	**.59**	.28	**.45**
Communication/marketing	**.60**	.21	**.79**	**.45**	**.77**	**.51**	**.69**
Barriers and facilitators	**.83**	**.49**	**.95**	**.71**	**.90**	**.75**	**.81**
Participation in health risk assessment activities							
Structure of program	.07	.01	.10	–.01	.23	–.02	.18
Communication/marketing	.28	.17	.36	.21	.38	.20	**.42**
Barriers and facilitators	**.57**	**.53**	**.60**	**.54**	**.54**	**.55**	**.51**

NOTE: The more comprehensive the implementation process the better the employee participation. $p < 0.05$, $r = .632$; $p < 0.01$, $r = .765$; correlations ≥ effect size of .40 are in bold.

Relationship Between Organization Context and Employee Participation

Employees participated in more agency-supported activities when managers ($r = .62$) and coworkers ($r = .56$) supported the HPDP program (Table 5). For participation in fitness activities only coworker support was related to greater participation ($r = .69$). None of these organization characteristics increased participation in health risk assessment activities. The data therefore support an overall relationship between organization context and employee participation in seven health-related activities, but not with participation in either fitness or health risk assessment activities.

We found differences when we examined the relationship between organization context and employee participation within the six employee subgroups. With respect to the seven health-related activities, management support had a greater impact on men, whites, and those in upper level jobs, as compared with women, ethnic minorities, and those in lower level jobs (Table 5). Similar disparities for management support were seen for participation in fitness activities. Additionally, whether time off for participation was allowed and presence of on-site facilities were characteristics more important to participation in fitness activities among employees who were women, ethnic minorities, or in lower level jobs, as compared to men, whites, and those in upper level jobs. Coworker support was important to participation in seven health-related and fitness activities for all employee subgroups. In contrast, the level of management support, coworker support, and organization resources did not influence participation in health risk assessment activities for any employee subgroup.

To assess the stability of the correlations obtained between the six study dimensions and three participation variables, each of the 10 worksites was dropped and new correlation coefficients were calculated on the remaining 9 worksites. Using the effect

Table 5. Assessment of Relationship Between Organization Context and Employee Participation ($N = 10$)

	Total	Gender		Race		Job Level	
Relationship Assessed	*r*	Men *r*	Women *r*	White *r*	Other *r*	Upper *r*	Lower *r*
Participation in seven health-related activities							
Management support	**.62**	**.73**	.38	**.69**	.25	**.70**	.04
Social environment	**.56**	**.40**	**.60**	**.52**	.37	**.53**	.33
Organization resources	–.21	**–.45**	.04	–.35	.02	–.30	.25
Participation in fitness activities							
Management support	.28	**.53**	.05	**.48**	–.14	.39	–.03
Social environment	**.69**	**.56**	**.64**	**.71**	**.58**	**.72**	**.55**
Organization resources	.24	–.04	.38	.12	**.42**	.16	**.50**
Participation in health risk assessment activities							
Management support	.16	.26	.07	.19	.02	.25	–.11
Social environment	.34	.37	.32	.34	.23	**.40**	.17
Organization resources	**–.44**	**–.50**	–.39	**–.49**	–.32	**–.47**	–.39

NOTE: The more supportive the organization context for HPDP program is, the better the employee participation.

$p < 0.05$, $r = .632$; $p < 0.01$, $r = .765$; correlations ≥ effect size of .40 are in bold.

size of .40 as the criterion, the 10 new sets of correlation coefficients yielded relatively few different decisions. We conclude, therefore, that the correlations we used to test the study's hypotheses were relatively robust, despite the wide confidence intervals.

DISCUSSION

As worksite HPDP programs have evolved from primarily executive fitness classes into more comprehensive programs available to both blue- and white-collar employees, recognition of the importance of reaching a broader range of employees—specifically higher risk and relatively underserved employees—has increased.[14,35-38] However, subgroup participation is infrequently reported in the worksite HPDP literature; when reported, the relationships between demographic characteristics of employees and employee participation are inconsistent.[10,39,40,41] From a public health perspective it is advantageous for worksite HPDP programs to involve a high percentage of all employees, especially higher risk individuals. Our purpose in this study was to identify organization factors that are related to participation of specific employee subgroups.

This study indicates that employees are more likely to participate in worksite HPDP programs if they work for organizations where employees endorse such programs. Disadvantaged employees (i.e., women, minorities, those with low-level jobs) are more likely to participate in HPDP activities if there are numerous efforts made to inform, market, and provide incentives to encourage participation in them; and if organizations make efforts to reduce barriers to employee participation. More advantaged employees (i.e., men, white, those with upper level jobs) participated more when management support for the program was strong.

Employee participation in seven health-related and fitness activities requires more of an ongoing commitment from employees, as compared to participation in a once-a-year health risk assessment. The more extensive the personal commitment required to participate, the more important we found management support, social environment, and organization resources to be. Participation in time-limited activities, in contrast to those activities offered monthly (health education seminars) or several times a week (fitness activities) was not associated with management, coworker, or organization support.

Implementation Process and Employee Participation

The extent to which these 10 agencies communicated information about their HPDP program activities to employees was directly related to overall employee participation in agency-supported fitness activities, but not to participation in health risk assessments or overall participation. Targeted marketing, personal contact, and the use of systematic incentives were especially important for participation in ongoing fitness activities by female, minority, and lower status employees (Table 4). Employees in lower level jobs also participated more in health risk assessment activities when barriers were reduced and varied marketing strategies used. Too often health professionals overlook communication and marketing of HPDP activities to encourage employee participation; program coordinators often assume all employees have received and understood messages announcing the details of upcoming HPDP activities. Freimuth and Mettger[42] suggest that health professionals find it difficult to reach individuals "unlike themselves."

Although the type of HPDP program structure implemented at an agency did not, in these data, have an important impact on overall employee participation, it was strongly associated with greater participation in fitness activities by female employees, minority employees, and employees in lower level jobs (Table 4). Because those groups may have relatively less occupational flexibility, agencies may need to offer more comprehensive or frequent HPDP activities if they wish to increase these groups' participation.

Providing activities at convenient times and locations increased participation. Additionally, agencies that facilitated participation by administering needs assessment surveys or conducting evaluations of their HPDP programs had higher participation rates, particularly among females, minorities, and those in lower level jobs (Table 4). Eleven individual variables were combined to represent actions an organization could take to facilitate or reduce barriers to participation (Appendix B). The strong association found between participation and the program implementation steps measured suggests that employees are more apt to participate in programs offered by organizations when evaluation data is used to improve those programs. In future studies it may be beneficial to investigate which specific actions organizations take are most important in reducing the barriers to participation.

Organization Context and Employee Participation

Management support for employee participation is *not* consistently important across all groups of employees. Greater management support was related to a higher rate of participation in seven health-related activities among employees who were male, white, and in upper level positions in agencies (Table 5). For minority employees and those in lower level jobs, management support was not particularly important for ensuring higher

participation levels. We do not know whether the finding that management support for participation by females, minorities, or those in low status jobs is not important to participation because these employees' participation patterns are less influenced by their managers or that such support was *perceived* to be lacking. In future studies it will be important to determine whether management support is consistently absent in large federal organizations for females, minority employees, and employees in lower level jobs or is lacking, also, in a more diverse sample of organizations. In either case it becomes imperative to determine whether lack of management support is due to latent (unintended) or manifest (intended) goals of the managers.

Management support is one of the most frequently mentioned factors in the literature on adoption and implementation of worksite HPDP programs.[38,41] We measured management support by combining different variables; two of these variables measured manager attitudes about the HPDP program, two measured employee perception of managers' support and attitudes, and one, derived from the case study data, assessed upper level management support. It is possible that dividing management support into separate dimensions and measuring it more specifically would identify more clearly how managers do or do not influence employee participation in worksite HPDP programs. For example, we do not know whether it is more important for managers to set a personal example for employees by actively participating themselves in program activities, or more important for them to explicitly encourage employees to participate, regardless of whether they themselves participate. It may also be important to measure support from first-line supervisors, middle-level managers, and upper level managers separately. An individual's style of management may also have an impact on employees' participation in HPDP program activities.[43]

Social environment in this study was consistently important in explaining employee participation for all employee subgroups, in contrast to the more restricted effect of management support. Kotarba and Bentley[44] found, as did this study, that employees were more apt to participate in program activities if they believed it was a norm in their worksites to participate. In contrast, Stange et al.[45] found that "perceived social support" increased employee participation only among nonwhite employees. Having a supportive social environment was particularly important for participation in activities requiring greater time commitment (e.g., fitness) compared to the more limited commitment required for participation in health risk assessment.

Having time off to participate, as well as having on-site facilities, was important for participation in fitness activities by minorities and employees in lower level jobs. Such support was not necessary for participation in health risk assessment activities among employees in any subgroup. The surprising negative association between organizational resources and participation, especially for men, whites, and employees in upper level jobs, suggests that time off to participate was perceived as flexibility to participate without reduction in expected work responsibilities. Time off may be more influential for participation by employees in lower level jobs who perceive that time as a reduction in their work day. A similar finding by Rost et al.[46] suggests that managers considered "on time" participation to mean in addition to regular hours, but nonmanagers considered "on time" participation to be a reduction in job demands.

Study Strengths and Limitations

A major strength of this study was its ability to derive a set of empirical findings from both qualitative and quantitative data and to simultaneously apply them to assess support

for our conceptual model of worksite HPDP program implementation. Use of multiple data collection techniques minimized the limitations involved with any single method. Caution needs to be taken in generalizing these findings to other worksite HPDP programs or even to other federal worksite HPDP programs, since the agencies included in this study were not randomly selected. Another limitation is lack of information about directionality of some associations; for example, participation rates may have influenced support of management and coworkers rather than vice versa. These data are useful, however, for identifying associations among variables and differences among subgroups, and for providing information about the hypothesized relationships.[42,47]

Our three outcome variables were constructed by contrasting employees who did not participate at all with those who participated at least once in a given agency-supported activity. Therefore, this analysis does not address factors important to frequent or regular participation. This limitation does not apply to our measure of employee participation in health risk assessment, since that activity is usually limited to one time per year.

Another limitation in how we defined our outcomes stems from the variability in number and type of activities offered by the different agencies. Both the mean number of seven activity types and the percentage participating in fitness activities were related to the number of offerings. Some of the organization attributes (e.g., communication and marketing, barriers and facilitators, decision making) were also correlated with the number of offerings. Thus those associations could have influenced the support for the conceptual model. For example, good communication and marketing in an agency with a lower number of offerings may not have been as effective in increasing participation. Future research should address this by using a participation measure that is standardized by number of opportunities to participate. We did not have adequate data in this study to create such a standardized measure. However, our findings of differences across employee subgroups would not be affected by this problem because all subgroups within an agency have the same number of activities available to them.

The greatest limitation of this study was its small sample size. Not only did a sample size of 10 restrict variability across some dimensions, it made it impossible to conduct a multivariate analysis to thoroughly control for confounding variables. The relative importance among the dimensions could be assessed only by examining single-order correlations between each of the six dimensions and employee participation. Factors other than those examined may be operating to influence employee participation within these agencies.

Our subgroup analyses did partially control for confounding. For example, an analysis of whites only cannot be confounded by race. However, because we did not simultaneously adjust for race, gender, and job level, it is possible that some of the differences among subgroups could be due to confounding by the other factors. For instance, the difference between men and women might actually be due to more women having lower level jobs. Our subgroup analyses tended to show similar findings for each of three disadvantaged subgroups (i.e., women, minorities, those with lower level jobs). Thus HPDP programs that reach any one of these subgroups seem likely to increase participation for all three.

CONCLUSIONS

The ecological perspective emphasizes the need for intervention on several different levels in order to promote and support individual behavior change.[1,48] In order to facilitate comprehensive interventions, program providers, evaluators, and health promotion re-

searchers have begun to investigate the influence of organization-level factors on employee participation.[38,39,41,46,49] Most of that research, however, has focused on worksites' adoption of restrictive smoking policies,[17,50,51] employee participation in smoking cessation programs,[41,52,53] or participation in such time-limited activities as health risk assessment or HPDP program orientation sessions.[38,46] Only very recently have researchers begun to assess worksite HPDP programs that involve ongoing, multiple health-promoting activities.[43,54,55]

We developed the organization conceptual model guiding this study to address questions about the relationships between organization factors, worksite HPDP program implementation processes, and employee participation in multiple HPDP activities. This model has proved helpful in identifying several relationships between organization-level factors and increased employee participation and in demonstrating how organization factors differentially influence HPDP program participation across employee subgroups. Several modifications could be made to improve the predictability of the model. These include dividing dimensions measuring multiple concepts, such as management support, and more finely defining employee participation to examine more specific relationships.

These data suggest that to promote greater participation in fitness activities among minority employees and those in lower level positions, worksites must provide a certain level of organization resources, especially time off to participate, on-site facilities, or fitness personnel responsive to employee needs and interests. Without these organization supports, equal participation across all employee subgroups is less likely to occur. This finding is consistent with the ecological perspective, which suggests that policy and environmental conditions conducive to health are needed to support individual behavior change.[48]

The findings from this study suggest that there are specific steps an organization can take to reduce barriers to participation in HPDP program activities. Because occupational safety and health programs also often involve individual behavior change that must be maintained over time, the findings from this study that support organization-level change—especially multiple communication strategies and supportive social environment—may also be important to safety programs.

Increasing participation among those at higher risk of disease and chronic health problems is important, given the growing health disparity among groups.[56] Worksite HPDP programs' focus on prevention will become increasingly important as the United States struggles to address the rising costs of health care and the inequities in health care coverage. Conclusions about the model and hypothesized relationships are obviously tentative, given the small sample size, until additional research leads to a more consistent picture or confirms some of the relationships suggested here. Nevertheless, our findings suggest avenues through which workplace HPDP programs can foster participation by high-risk groups, including ethnic minorities and those in lower level jobs.

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Appendix A
Organization Context Variables by Dimension

Variable by Dimension	Measures	Value
Management support		
Upper level management support	Dichotomous	Y/N
HPDP program should be offered[a]	Percentage[b]	1-5
Should allow time off to participate[a]	Percentage[b]	1-5
Manager supports participation[a,c]	Percentage[b]	1-5
Manager participation[a]	Percentage[d]	1-7
Social environment		
Program discussed among employees[a]	Percentage[b]	1-5
Feel bad if I don't participate[a]	Percentage[b]	1-5
HPDP programs should be offered[a]	Percentage[b]	1-5
Program generates enthusiasm[a]	Percentage[b]	1-5
Organization resources		
Separate budget for program	Dichotomous	Y/N
Time off to participate	Dichotomous	Y/N
Staff variety	Dichotomous	Y/N
On-site fitness facilities	Dichotomous	Y/N

NOTE: Variables operationalized from the qualitative data unless superscripted.
a. Variable operationalized from the employee survey data.
b. Percentage of respondents who "strongly agreed" and "agreed" with the statement.
c. Item from employee survey was reverse coded.
d. Percentage of managers who participated in any agency-supported activity.

Appendix B
Implementation Process Variables by Dimension

Variable by Dimension	Measures	Value
Structure of program		
Number of activities in 6 months	Categorical	1-3
Modified WELCOA standard	Categorical	1-3
Communication/marketing		
Marketing to high-risk groups	Dichotomous	Y/N
Use systematic incentives	Dichotomous	Y/N
Marketing[a]	Categorical	Mean
Participation barriers and facilitators		
Completed needs assessment	Categorical	0-2
Conduct overall program evaluation	Categorical	0-2
Conduct evaluation of activities	Categorical	0-2
Use evaluation information	Dichotomous	Y/N
Coordinator identified as key	Dichotomous	Y/N
Convenient location[a]	Percentage[b]	1-5
Convenient time[a]	Percentage[b]	1-5
Activities are boring[a,c]	Percentage[d]	1-5
Activities are expensive[a,c]	Percentage[d]	1-5
Too much time required[a,c]	Percentage[d]	1-5
Individual instruction[a,c]	Percentage[d]	1-5

NOTE: Variables operationalized from the qualitative data unless superscripted.
a. Variable operationalized from the employee survey data.
b. Percentage of respondents who "strongly agreed" and "agreed" with the statement.
c. Item from employee survey was reverse coded.
d. Percentage of respondents who "strongly disagreed" and "disagreed" with the statement.

Linking Stress and Injury in the Farming Environment: A Secondary Analysis of Qualitative Data

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The first step in injury prevention is to understand the injury problem. This includes examining the nature of the problem from the perspective of the target community. This article uses qualitative methods to explain the nature of the injury problem and identifies prevention strategies through a three-step process: identify a causal model, validate the model, and identify strategies using the causal model. A causal model linking safety performance and safety demand, health decision making, and occupational stress was derived by secondary analysis of farm family focus group data (step 1) and validated by other farm family focus groups (step 2). Prevention strategies identified from the causal model (step 3) include decreasing the number of roles performed exclusively by one individual, developing an easy-to-use planning tool that assists farmers in anticipating and reducing future work demands, and developing an education module that incorporates injury costs into safety decision making.

Injury control is accomplished by a process of identifying a problem, designing and implementing programs and interventions to address that problem, and evaluating the results. The elements of problem identification in injury control include descriptions of (1) the nature of the injury problem, (2) the community's perception of the injury problem, (3) the characteristics of the population, (4) available resources for prevention, and (5) the political climate.[1] Epidemiologic surveillance and accident investigation methods can help describe the nature of the injury problem (i.e., the first of the elements above) by identifying the hazards and behaviors that are the immediate causes of injury, the relative public health impact of different types of injury, and high-risk populations. However, this information is not sufficient for designing prevention strategies aimed at encouraging safe behavior or adopting control measures to abate hazards. Well-designed prevention

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strategies should be based on a more comprehensive understanding of the nature of the injury problem, including why the hazards and unsafe behaviors occur in the first place. In the case of injuries at work, it is particularly important to identify variables in the psychosocial, economic, and physical environment that influence safety decision making, and the degree of vigilance maintained throughout the conduct of the task.

In a three-step secondary analysis of focus group data, we were better able to understand the relationship between stress and injury in farm families. The first step was to identify the constructs of injury causation and prevention that are salient to the target audience and describe how these constructs are perceived to be related in a causal model. The second step was to confirm or validate the causal model. Finally, the third step was to identify prevention strategies based on the causal model.

WHY USE QUALITATIVE METHODS?

Qualitative research methods are used to develop a more differentiated and detailed view of a phenomenon. In qualitative research, analyses and interpretations are constructed and verified by the perceptions of the target audience. Qualitative methods are preferred to quantitative methods when there is little information known about a phenomenon, the applicability of what is known has not been examined, or when there is reason to doubt the accepted knowledge about a given phenomenon. In the occupational environment, these methods best capture the individual's point of view regarding the individual's work, examine the constraints of a work role, and secure rich descriptions of the work situation.[2]

The minimization of error is important in every research design. In quantitative research designs, researchers are primarily concerned with Type I error (rejection of the null hypothesis when it is correct) and Type II error (failure to reject the null hypothesis when it is false). Quantitative researchers have multiple methods to negotiate the balance between these competing types of error. But these methods do not address what has been called Type III and Type IV error (i.e., problems associated with external validity).[3,4] Type III error is the validity problem of asking the wrong question. Type IV error is the validity problem of solving a problem not worth solving. Qualitative methods help to reduce the chances of committing Type III and Type IV error by means of constant comparison of statements and reverification of meanings with the participants. Using an iterative process, cases are examined, phenomena are redefined, and hypotheses are reformulated to remain consistent with the informants' descriptions and explanations.

THE ORIGINAL STUDY

The aims of the original study were to (1) identify safety decision making patterns of older farmers, (2) determine what health risks they perceive, and (3) determine how risks are prioritized in terms of risk avoidance behavior.

After the initial data were collected and analyzed, the secondary analysis of the focus group transcripts was structured to explore the concepts of stress and injury. The focus group transcripts were analyzed to examine the role of work-related stressors in farming and the potential relationship between exposure to stressors and risks for injury. Although design and sample will be discussed to clarify the source of the data used in the secondary analysis, only findings of the secondary analysis will be reported in this article.

THE SECONDARY ANALYSIS

Design

An exploratory study using focus group methodology was conducted to describe how farm families view the relationships between occupational context and worker behavior. This context includes multiple economic and social factors that are difficult to evaluate with quantitative methods because the salient factors and how to measure them are not known in advance of the study. Even if some of these factors are known, there may not be enough variation in exposure to permit quantitative studies. For example, all soybean farmers in a given area may be exposed to the same low prices for their crop.

A focus group is a collection of members of a target audience who participate in a group interview conducted by a skilled moderator with the intent of gaining a better understanding of a phenomenon of interest to the target audience and investigators. Focus groups are economical in terms of time and money because constant comparison and verification of meaning is done by group members during the actual interview, which saves potentially enormous amounts of post hoc follow-up. Focus groups, as opposed to individual interviews, were selected as the method of data collection because there were severe budget and time limitations for study completion, there was fear in the farming community regarding the intentions of the research (i.e., future regulation), risk-taking behavior is a salient concern, consideration of this behavior in a group context may promote individual honesty, and the literacy level of our farming community was not known. Focus group methods are well suited to farm communities because farming has a rich oral tradition, and most work practices are taught orally to youths as they practice various psychomotor skills.

The value of focus groups in occupational health is their ability to discover problems with regulation enforcement prior to implementing policy, examine the views of the worker regarding engineering changes, and understand the complexity of the work performed in order to appreciate health and safety issues. Because they provide information regarding the range of opinions or experiences that people have,[5] focus groups are useful in exploring hazardous work situations.

Data Collection

The primary data were collected using a structured interview guide developed from the farm injury literature. The interview guide was used to initiate and refocus questions and discussion if necessary. However, a low level of moderator input was used. Group sessions were audiotaped. Tapes were transcribed verbatim, with names changed to maintain anonymity and confidentiality. Informed consent was obtained prior to participation.

Sample

The study used a total of 12 focus groups; 9 of these were analyzed in the secondary analysis. Participants were recruited by county extension agents and were eligible to participate if they were 55 years of age or older. This age was chosen because it is just above the mean age of farmers nationally (53.3 in 1992, 52.0 in 1987[6]). An effort was made to represent various types and sizes of farming operations.

A total of 394 pages of transcripts, consisting of 1,292 data units from nine focus group interviews with 70 farmers and/or spouses were examined as part of the secondary analysis of agricultural stressors and injury.

Analysis

Analyses included coding transcripts for the first six focus groups and using data from the last three focus groups to validate and reverify the findings. A keyword coding dictionary was drafted from stress-related studies in farming ($N = 43$). The dictionary provided a perspective of what was expected based on the existing literature in relation to agricultural stressors to compare with what farm families in the focus groups actually experienced. Next, the types of statements that were going to be considered a data unit for the purposes of coding were defined. The types of discourse coded were (1) farmers' definitions of a problem, (2) farmers' perspectives about the problem, (3) activities performed and changes in activities over time, (4) strategies for accomplishing certain outcomes, and (5) special work situations. Each statement was coded to include (a) who was involved, (b) what was happening, (c) when an activity or situation occurred, (d) why it happened, (e) where it happened, and (f) how an activity was organized.[7] New coding categories were developed for information not listed in the literature but discussed by the farm families and identified through transcript analysis. The coding dictionary went through five iterations. A one-page summary of version five of the dictionary is listed in Table 1.

Interrater reliability of the coding was calculated using the kappa coefficient.[8] The kappa coefficient was selected because it controls for chance agreement of two raters by devaluing agreement at high or low frequency compared to moderate frequencies and, as such, can be considered similar to a weighted statistic. Two members of the research team coded each of the six transcripts independently. Then, 10% of the coded discourse segments were randomly selected, and coding reliability was calculated. The kappa coefficients ranged from .70 to .85. Values of .75 and greater denote excellent agreement, with .70 indicating good agreement.[8]

Next, data were entered into the FYI 3000 qualitative data software program.[9] This program compares discourse segments using a keyword system. Data can be displayed using multiple keywords at a time. Initially, data were displayed using each keyword. Later, printouts were obtained by combining keywords that were linked together on a conceptual basis by explanatory or interpretative statements of the participants.

Participants may describe single constructs (concepts, ideas, themes),[4] multiple constructs, or may explain and interpret the relationships between the constructs. From these descriptions and explanations, the researcher builds a model of linked hypotheses. Each construct is a feature of the phenomenon under investigation, and each explanation or interpretation describes one or more of the hypotheses linking the constructs together to make a model. Throughout each step in building the model, the researcher is constantly searching for disconfirming statements or incongruent interpretations from participants. This is the process of replicating findings and verifying hypotheses within a single study.

Using the data from the printouts, Hurrell and Murphy's[10] general framework for a model of occupational stressors and strain, and Glaser's framework for identifying grounded theory,[11] a stress and injury model was identified. The printouts were reviewed from the perspective of the questions in Table 2.

Table 1. Farm Focus Group Coding Dictionary

Coding Category	Number of Responses Coded	
Job stressors: physical, psychological, social		1,624
Workload characteristics: hours, time pressures	168	
Farm/personal finances: debt/assets	114	
Physical environment (nonhazards): terrain, breakdown	239	
Hazard risk: equipment, animals, chemicals	468	
External conditions: economy, regulations	95	
Mental demands: decision making, overload	181	
Nonfarm role: off-farm work, full- or part-time	28	
Family work role: family members, child care	131	
Farm characteristics: size, productivity, commodities	70	
Cultural values: family tradition, norms	41	
Personal characteristics: stubbornness, suspicion	89	
Acute stress reaction: transient reaction to stressor		121
Psychological: anxiety, carelessness	76	
Physiological: physical fatigue, back pain	38	
Behavioral and family: sleep problems, alcohol	7	
Chronic strain: cumulative stress or disability		28
Physical: injury, illness, disability	28	
Psychological: depression, burnout, marriage, family	0	
Strategy: problem solving, coping		191
Farm management: consultation, information	49	
Discussion/conversation/social support	10	
Anger/denial/avoidance	3	
Leisure: rest breaks, hobbies	21	
Utilization of technology: telephone or radio communication	47	
Home management techniques/check-in times: meals, visits	19	
Advanced planning: weather forecasts, moving equipment	21	
Education: formal class	21	
Buffers: diminish perception of, or reaction to, job stress		72
Personal characteristics: good attitude, self-esteem	32	
Social support: structural, functional (instrumental, emotional)	40	
Total number of coded responses/problems		2,036
Total number of data units coded	1,292	
Number of focus group participants	70	

Table 2. Printout Analysis Guidelines

1. Count the frequency of the idea.
2. Identify other constructs/keywords related to the original keyword.
3. Can a keyword be subsumed within another keyword? If so, state the rationale.
4. Has a keyword been misdefined? Redefine it and give the rationale.
5. Identify any sources of moderator influence.
6. Identify any sources of a groupthink process (i.e., group-influenced bias or coercion).
7. Identify any sources of consensus or disagreement. Describe possible meaning in any discrepancy.

The next step was to examine the transcripts from the three remaining focus groups to validate the constructs identified by the first six groups. Replication of findings and verification of hypotheses occurs when the researcher selects new participants to test the model. The researcher may ask confirming or challenging questions to verify a statement or interpretation. As new insights are identified, they are linked into the existing model. If the new insights are not compatible with the model, then both the insights and the model are challenged. As with all hypothesis testing, the search is for solid, disconfirming evidence.[4] This iterative process of model building and hypothesis testing illustrates the core strength of qualitative methods.

The model in this study was validated by coding transcripts from the final three focus groups. Interrater reliability was assessed as described earlier. Printouts were generated that examined each model link by combining keywords. The same themes were identified in these latter groups using the framework applied to the transcripts that was generated from the first six groups.

As another validity check, a researcher not involved with the preceding analyses used the keyword dictionary to code focus group data obtained in a separate and different study designed to explore stressors and coping strategies of farm families.[12] The coding dictionary and its derived definitions proved to be a suitable framework for examining stress and coping among farm families in this study.

Finally, the last step was to identify prevention strategies based on the causal model to be used in future research as a deductive test of the model.

RESULTS

The oldest participant was 79 years of age and the youngest participant was 52 years of age. Only 3 participants were younger than 55 years and they were spouses of farmers over the age of 55. Over half of the participants (56%) rated their health as excellent or very good. Of the respondents, 23% had experienced an injury while farming that was severe enough to make them miss work; 9% were hospitalized for this injury. The most common work-related injury events were falls (11%), tractor rollovers (9%), and machinery operation (limb amputations) (6%). Several participants (27%) were employed off the farm in addition to operating their own farm.

Farm size varied greatly. The smallest farm was 125 acres and the largest was 2,000 acres. The mean acreage under crop production was 100. The majority of participants grew tobacco, with alfalfa, corn, and hay being the next most common crops. Beef and dairy cattle were the most common types of livestock. These demographic data reflect the diversity seen in Kentucky farms.[13]

The stress-injury model presented in Figure 1 shows a cross-sectional "snapshot" of the hypothesized farm family stress and injury model. The data, and themes generated from the data, are presented in Table 3.

Each box in Figure 1 represents a construct or set of related constructs. Each arrow represents a hypothesized relationship between the constructs. The direction of the relationship is indicated by an arrowhead. The absence of an arrow between two boxes indicates a hypothesis of no direct relationship. The constructs used in the model are defined briefly in Table 4.

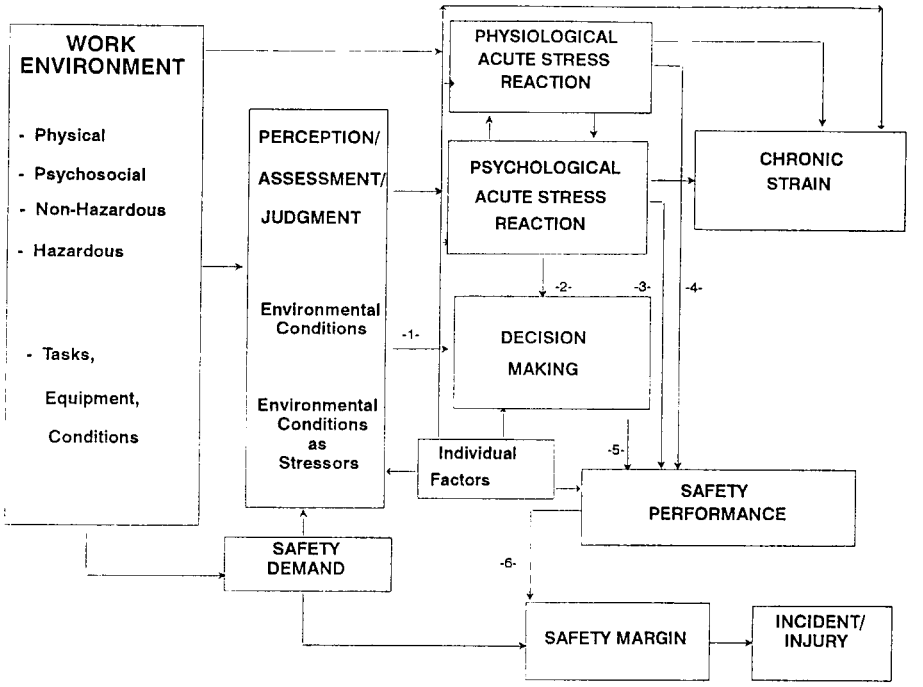

Figure 1. Model of farm family stress and injury.

The Pathways

In a model of this nature, the proliferation of numerous paths or hypotheses can seem daunting and anything but parsimonious. However, only some of the paths are critically important to demonstrate a link between occupational stress and injury in the model. Other paths are important to complete the picture, but may not lead to interventions. The most important paths for identifying reality-based injury prevention strategies are as follows: perception/assessment/judgment (PAJ) to decision making (path 1, Figure 1), psychological stress to decision making (path 2), psychological stress to safety performance (path 3), physiological stress to safety performance (path 4), decision making to safety performance (path 5), and safety performance to safety margin (path 6). These are the most critical paths since (1) they link a model of stress with a model of safety behavior and (2) they clarify the relationship between work environment, decision making, and safety performance on specific tasks. Farmers in this study repeatedly used the work environment to explain their decision making and rationale for unsafe work behavior. Thus one important causal pathway that emerges from the qualitative analysis is that a farmer's workload, along with other features of the farm work environment, may have a profound effect on the risk factors for injury on the job.

The farmers identified several determinants of workload as important, for example, (1) the number and complexity of tasks to be performed in a workday, and (2) the availability of resources (money, trained hired help, access to equipment parts) to help reduce the work-related burden. Some safety features were also identified as factors that increase workload. For example, proper wagon hitching and unhitching requires frequent disembarkment from the tractor. If one uses the seat belt, this action takes more time to

Table 3. Analysis Questions and Generated Themes

Question	Theme	Supporting Data
What are the consequences of farm work stress?	Injuries, low productivity, illness	"Farming is dangerous . . . biggest risk there is in any kind of occupation." ". . . so you try to speed your operation up and every one of us farmers takes a certain amount of chance every time we go out to complete a job which is hazardous. If you are working with animals, working with a bull, working with a piece of machinery which can destroy you within one lick, or a tractor . . . so any time you are out there." "We do so many things. I think we are more injury prone than if we were in the workplace where you have some fellow saying, 'Hey do it this way'."
What causes farm work stress?	Economic conditions (accumulation of personal and external economic forces); weather; resource supply (lack of labor, equipment parts, animal chutes); farm tasks (multiple roles in farming); high workload (high level of work demands); farm hazards (e.g., bush-hogging, chemical spraying, animals, and other hazardous equipment)	"We do so many things with so many different [pieces of] equipment, I think you are subject to more kinds of injury. You have to be a veterinarian, accountant, mechanic, and electrician." "Farmers work very long hours and they become very fatigued and I think that can cause carelessness. And it is not just one day of long hours; it can be 8 days or 18 days of long hours." "You have to realize you are responsible for the people who work for you . . . .Maybe the younger people don't feel that liability, but we feel responsible, . . . And you are just as concerned with them as you are with family."
Under what conditions does exposure to farm work stressors lead to psychological and physical strain?	Conditions of poor market prices; too much or too little rainfall or rainfall during planting and harvest; unskilled or no labor force; malfunctioning equipment; the need to perform multiple tasks using multiple pieces of equipment	". . . in the spring of the year and you have to get things done and it has rained and rained and rained and you can't get in the fields and the time to get it in is getting so close and you have major breakdowns day after day and then his temper gets terrible and he is hard to live with. I usually just avoid any contact with him. . . . I worry about him when he gets in this

(continued)

Table 3. continued

Question	Theme	Supporting Data
		particular state, and I tell our son to watch him real close because I know he gets careless and something happens" (a farmer's spouse).
In what context does farm work stress and injury occur?	In the context of greater mental demands and greater quantitative workload responsibilities (number of tasks to be completed and their energy expenditure); the cumulative nature of the overall farm workload and not just the workload associated with particular tasks that may influence injury susceptibility; thinking about future work may decrease attention to salient cues from the work environment	"There's more individual judgments and decisions made in farming than any other occupation." "I have a baler with a kicker on it and I think it is the greatest thing that ever was because it saves me a lot of labor. I've had it for 15 years and I guess I've gotten familiar with it to the point that I've gotten careless. I remember when the kicker on the baler hit my arm when I left it running. I wasn't even thinking about it. I was thinking about something else I had to get done. When you are overcome with stress it makes you tired and more likely to have an accident."
What factors (contingencies) influence the outcomes of injury, illness, and low productivity?	The farmer's perception of the risk involved in performing farm tasks under stressful conditions; tendency to ignore recommended procedures (safety rules) even though the proper procedures are known (carelessness); when bending a rule is expected to shorten job completion time; productivity and economic survival drive the safety-related decision-making process more than concern about injury; familiarity with equipment may, in some cases, decrease the perception of risk or hazard	"You think it is good enough to get by. It makes me real aggravated to see on the piece of equipment, 'don't take the shield off'. Well, I know not to take it off, but if the dumb thing falls off I probably won't put it back on. We'd all be bankrupt if we put on every shield that fell off. If your baler breaks down and it is threatening rain, you'll jerk the shield off, fix the problem, and not put the shield on cause you have got to get started baling. A load of hay is valuable." ". . . the idea of, 'Well I can get by a few more days' . . . and you say, 'Well I am going to finish this job before I will have to do anything about the brakes and it is going to rain tomorrow so I got to get this job done today'. So it is carelessness in a sense because you feel like you can complete the job without having an accident."

(continued)

Table 3. continued

Question	Theme	Supporting Data
What categories change with the changes in another category (covariances)?	Time pressures, long hours, and fatigue change as workload (both quantitative and mental demands) changes; changes in judgments about injury risk and productivity are associated with changes in long hours, time pressures, and fatigue	"You are always in a hurry. You are always under stress. You're gonna leave some things undone." "... accidents are caused by carelessness, lack of funds to keep machinery repaired sometimes. Long hours you have to put in to try to ... you don't ever get any more for your product, you just put in more hours and get a little more volume."

Table 4. Brief Definitions of Model Constructs

1. Work environment (WE): The entire physical and psychosocial environment at work, including job and task characteristics, work organization, hazards, and other conditions of work.
2. Safety demand (SD): The hazards and other features of the work environment that combine to require a minimum level of human performance to avoid an incident or injury.
3. Perception/assessment/judgment (PAJ): An individual worker's evaluation of one or more feature(s) of the work environment.
4. Individual factors: Job-related individual factors include a broad array of categories that are related to one's occupation, may influence workplace experiences, and are presumed to vary with each individual worker.
5. Physiological acute stress reaction: Physiological and behavioral manifestations of exposure to stressful features of the work environment.
6. Psychological acute stress reaction: Psychological and behavioral manifestations of exposure to stressful features of the work environment.
7. Chronic strain: Psychological, physiological, and/or behavioral manifestations of long-term, cumulative exposure to stressful features of the work environment, usually associated with a measurable decrement in overall health status.
8. Decision making (DM): Cognition associated with work-related behaviors, performance, or the work environment (i.e., the process of deciding—including "deciding not" or "not deciding"—to do something related to work).
9. Safety performance (SP): The level of human performance required by the safety demand in the environment to avoid an incident or injury.
10. Safety margin (SM): The difference between safety performance and safety demand.
11. Incident/injury: The initiation of an incident or the severity of injury given that an incident has been initiated. An incident is initiated as a result of a negative safety margin.

buckle and unbuckle, plus there is the danger of tripping. In this case, safe behavior adds time and thereby contributes to workload. Some farmers find it time-efficient to develop a remote device (such as a string or wire) with which they can pull the hitch pin out without disembarking. The danger in this behavior is the farmer cannot ascertain if the tractor and wagon are level with one another. Therefore, when the hitch pin is pulled, the wagon may jackknife, creating instability in the tractor. The key stress reactions to this workload that influence safety performance were identified as (1) the fatigue level of the farmer (influenced by both mental and physical aspects of the work) and (2) the overall emotional state of the farmer.

Hypotheses suggested by the stress and injury model are as follows: (1) when farmers are fatigued, they may fail to increase their safety performance to respond adequately to a changing (e.g., more hazardous) work environment (e.g., increased safety demand), and (2) major financial, workload, and work environment planning decisions (e.g., commodity decisions, size of operation, purchases) have a significant impact on the competing demands of farm work.

DISCUSSION

The relationship between workload and injury as described by the farmers is compatible with the long tradition in human factors research and practice that relates the various dimensions of workload to performance, including safety performance.[14,15] The strongest epidemiologic support for this hypothesis to date comes from a longitudinal study of dairy farmers in central New York.[16] The number of acres under tillage (or milking cows) per worker was strongly associated with injury. Farm owner-operators on farms with more than 30 acres under tillage per worker and who worked more than 60 hours per week were 2.78 times more likely to sustain an injury. To the extent that this association was causal, 51% of injuries were attributable to these risk factors (i.e., would not have occurred if this level of exposure to workload and long hours had not been present).

The hypothesis that fatigue affects safety performance has a long history in human factors research.[17] Both human factors research and epidemiologic research have documented the role of fatigue in vehicle crashes.[18,19] Fatigue has been identified among truck drivers, who like farmers suffer economic pressures to work very long hours. Findings in this study provide additional evidence that fatigue is an important risk factor in the farm environment as well.

The determinants of safety decision making have been explored in various disciplines such as health behavior and economics. In this study, we explored how farmers prioritize economics above other factors in their safety decision making. However, the data did not support the hypothesis that a lack of knowledge regarding hazards influenced safety decision making. Farmers believed they had expert knowledge of most injury prevention strategies, and that lack of knowledge was not a key risk factor for injury. The focus group data provide ample evidence that for these experienced farmers, these beliefs were justified. Therefore, interventions that merely emphasize acquisition of instrumental knowledge about safe task performance are not likely to be effective in preventing injury.

The current economic environment of farming encourages expansion as the principal strategy for surviving competitive pressures.[6,20] Not surprisingly, workload increases with farm expansion. Unless carefully planned, the heavier workload may precipitate fatigue and increase risks for injuries.

Several farm finance ratios already exist that provide information regarding a farm's liquidity, solvency, profitability, repayment capacity, and financial efficiency.[21] Similarly, it may be possible to construct an index that shows how labor requirements will increase following a particular type of expansion. By gaining a detailed understanding of future work demands, including seasonal fluctuations, farm families will be in a position to better plan for increased workload in subsequent months. The result of effective planning should be a reduction in the work demands on the principal farm operators, reduced fatigue, and a more controlled and stable level of risks for injury.

Conclusions

The farmers linked the constructs of safety demand, safety performance, health decision making, and occupational stress into one causal model of injury. These areas of the literature have been applied to injury control;[10,22,23] however, to the researchers' knowledge they have not yet been integrated. Furthermore, the results of this study clarify how to operationally define the model constructs in the farming environment.

Findings show that farmers' decisions are typically framed within an economic model where the costs of possible injury outcomes are not weighted heavily. Qualitative data suggested prevention strategies should include informing farmers about the economic impact of injury, thus allowing safety to become a competing demand in their decision making. Prevention strategies targeted at the farmer are most effective when they are based on the farmer's perceived reality and when they reflect the farming community's priorities. Interventions developed from the theoretical perspective that lack of knowledge is a reason for unsafe behavior may not be well received by the target audience.

Findings from our secondary analysis added to the state of knowledge concerning workload and injury in two ways. First, it was shown that farmers actually perceived workload to be a risk factor of primary importance. Second, specific dimensions of workload were uncovered that may be important for designing injury prevention strategies from engineering, environmental, and educational perspectives.

In our secondary analysis, farmers perceived economic stressors and excessive workload to be the primary determinants of safety hazards and behavior. The dimensions of workload that were particularly important include job and task complexity and lack of time. Furthermore, the decision to adopt or maintain an engineering control or safe work practice was primarily driven by perceived effects on productivity rather than risk to health. Based on these hypotheses from the model, the following three injury prevention strategies were identified by the researchers and farmers: (1) decrease the number of roles performed exclusively by one individual; for example, contracting out for certain services (e.g., equipment repair or pesticide application) may decrease mental and physical workload demands on the individual farmer; (2) develop an easy-to-use planning tool that assists farmers in anticipating and reducing future work demands; finally (3) develop an educational module that incorporates injury costs into safety decision making. Such a module would compare the costs of intervention to the costs of injury. Injury costs would be discussed in terms of days lost from work, untended animals, labor replacement costs, and uncovered/uninsured health care costs.

Identifying prevention strategies from the causal model is a separate process from selecting the best prevention strategies to address a problem. In community-based approaches to public health practice,[24-27] this final step of identifying the best prevention strategies is the responsibility of the community, in whole or in part, based on its perception of likely effectiveness, acceptability, and constraints.

The focus of identifying immediate hazardous behaviors and conditions that lead to injury (e.g., unguarded equipment, failure to shut off equipment in use) is common in traditional accident investigation.[23] Yet this approach is not well developed to take into account the underlying determinants of an incident or injury such as economic demands that may encourage the farmer to "get by," take short cuts, keep going despite fatigue, or decide not to install or maintain a piece of protective equipment. Like occupational safety research and practice in the behavioral sciences, management, and ergonomics traditions,[28] the approach taken in our secondary analysis enables the exploration of underlying injury determinants.

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Operationalizing Theoretical Constructs in Bloodborne Pathogens Training Curriculum

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This article describes how the protection motivation theory (PMT) was used to inform the production of video curriculum for a bloodborne pathogens training program for hospital nurses. Although hospital nurses are well acquainted with the work practices designed to prevent bloodborne pathogen exposures (universal precautions), there is evidence that they do not always follow them. First, the original PMT is adapted to reflect what is currently known about the role of affect in health behavior prediction. Second, the authors show how the four PMT message constructs—probability of occurrence, magnitude of noxiousness, response efficacy, and self-efficacy—guided the planning, shooting, and editing of the videotapes. Incidental to this process was the operationalization of these message constructs in such a way that affective reactions would result. The results show that this video curriculum successfully aroused negative affect in the target audience. Only by carefully planning and documenting how message constructs are operationalized in health education materials can one be sure of achieving theory-based (and thus the most replicable) message design.

Lewin's dictum that there is nothing so practical as a good theory[1] has, for decades, been a kind of rallying cry for theorists who sometimes must bear the criticism that their work is not very useful for solving real problems. However, many practitioners who use theory to guide their work might rightly reply to Lewin that "there is nothing less practical than a bad theory." Health behavior theories should provide guidance to health educators on specific problems such as curriculum design and/or health behavior assessment. One key to usefulness of a theory lies in its constructs. Constructs are the parts of a theory,

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the A and B in the "If A, then B" statement. If these constructs are not sensible and not readily applicable to a practitioner's needs, then the practitioner will not rely on that theory for guidance.

Practitioners have the difficult job of operationalizing constructs. For the purposes of this article, *operationalization* will be defined as *putting a theoretical construct to work in an applied setting.* Typically, operationalization occurs when one develops questions for a survey, a test, or an interview. For example, factual questions asked of subjects on a posttest may operationalize a measure of a knowledge construct. That measure may be compared to an operationalization of a health behavior construct, for example, to test the theory that knowledge of a health problem is connected with preventive action. The process of construct operationalization is thus frequently used to evaluate health education efforts. But its use in developing those efforts has been less widespread.

In this article we discuss how to use health behavior theory in instructional design. Specifically, we describe how theoretical health message constructs were operationalized in occupational health training materials designed to prevent bloodborne pathogens exposures among health care workers (HCWs). Those constructs originated in one of the few health behavior theories that provides even limited guidance about the design of interventions, Rogers' protection motivation theory (PMT).[2] In this article, we first provide a brief introduction to the occupational health behavior problem: universal precautions compliance among HCWs. Then we discuss PMT and explain how we adapted PMT to current evidence regarding the role of affective mediating variables in determining health behaviors. Next, we describe the process of producing video curriculum that operationalizes the message constructs of the modified PMT. From planning the videotapes, to shooting the footage in a hospital setting, to editing the tapes into coherent expressions of the constructs, we detail the influence of theory on the work of instructional design. Our purpose is to show how a systematic use of theory is important throughout the health education process, not just in the use of measures to evaluate it.

USE OF UNIVERSAL PRECAUTIONS BY HEALTH CARE WORKERS

The threat of infection with bloodborne pathogens became a serious concern to HCWs with the advent of the acquired immunodeficiency syndrome (AIDS) epidemic. The occupational risk of exposure and subsequent transmission of bloodborne pathogens such as hepatitis B virus and human immunodeficiency virus type 1 (HIV-1), the virus that causes AIDS, has been documented among HCWs.[3] Nurses and lab workers have reported the highest number of HIV-1 infections from occupational, primarily percutaneous, exposures.[4] To help prevent these exposures, the Centers for Disease Control and Prevention (CDC) recommended as early as 1987 that HCWs treat all patients as if they were infected with a bloodborne pathogen. Thus the recommendations are termed *universal precautions* (UP). Most of the recommendations were later mandated by the Occupational Safety and Health Administration's (OSHA) Bloodborne Pathogen Standard.[5] In spite of these developments, UP compliance rates remain suboptimal.[6] Both observational and self-reported studies have shown low UP compliance rates, especially with respect to barrier protection, with rates for certain practices dipping below 50%.[7,8,9] Blood and body fluid exposures continue to occur at unacceptably high rates.[10] Thus there is a continuing need for workplace interventions that will increase UP compliance and reduce exposure risks.

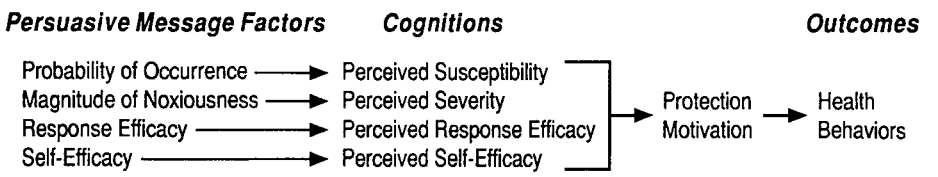

Figure 1. The protection motivation theory.
SOURCE: Adapted from Rogers,[2] Maddux and Rogers,[26] and Witte.[27]

Under OSHA rules, annual training on bloodborne pathogens is required for anyone who may reasonably be expected to come into contact with blood or other bodily fluids.[5] This training presents a challenging opportunity to health educators. The specific UP behaviors (e.g., putting on gloves, disposing of needles and other sharps properly) are widely known and not difficult to perform under ideal circumstances. The problem is performing the tasks while simultaneously providing care to patients. Many HCWs perceive patient care responsibility as superseding self-protection responsibility. If it is to be effective, bloodborne pathogens training must motivate HCWs to actually perform UP *in a demanding environment.* Simple skill training is not enough.

Theory for Occupational Safety Instructional Media Development

Protection Motivation Theory

Protection motivation theory is particularly well suited to guide the development of health education interventions because it attempts to explain responses to environmental messages with an information processing framework.[2,11] That is, compared to other models (e.g., theory of reasoned action,[12] the Health Belief Model[13]), PMT proposes specific message characteristics (see leftmost portion of Figure 1) that predict certain psychological states of the individual (middle of Figure 1), which ultimately lead to health behaviors (right side of Figure 1). The four persuasive message constructs in Figure 1 lead directly to four cognitive mediating processes. First, information in the message (i.e., training curriculum) about the probability of occurrence of a health threat leads to perceived susceptibility (one's perception of the likelihood of sustaining an injury or illness from conditions as they currently stand). Second, information about the magnitude of noxiousness of the health threat leads to perceived severity of that threat. These two constructs involve information and perceptions about how much discomfort or, in general, how serious the consequences are of experiencing the health threat. For example, in the case of the HIV-1 virus, strong ceiling effects have been shown among college students for perceptions of the severity of infection, probably because there is no known cure for AIDS.[14,15,16] Third, response efficacy information leads to perceived response efficacy and fourth, self-efficacy information leads to self-efficacy perceptions. Response efficacy may be defined as the capability of the recommended behavior to be effective against the health threat.[17] Self-efficacy may be defined as one's expectations of coping successfully with the health threat.[18] Finally, PMT proposes that the cognitive mediating processes together lead to protection motivation, which is usually operationalized as intentions to perform the recommended behavior,[11] as well as actually performing the recommended health behavior.

The PMT has been used extensively to investigate persuasive health message effects.[19] Rogers and his colleagues used it to investigate messages on smoking, sexually transmitted diseases, and driving;[20,21] exercise;[22] a (fictional) new virus;[11] and alcohol consumption.[23] These studies and others[14,24,25,26] provide evidence of the value of PMT constructs in predicting the outcomes of health messages. Although Rogers[11] subsequently proposed changes in the PMT, Witte[27] has pointed out the advantages and clarity of this original version.

The Role of Affect

The PMT typifies the emphasis of most health behavior theories on cognitive constructs and the neglect of affective constructs, a deficiency discussed by Dillard.[28] Affect has been defined as the product of a person's assessment (either consciously or unconsciously) of match between personal objectives and experienced stimuli. A close match between experiences and objectives leads to positive affect. Lack of match leads to negative affect.[29] Affect therefore has a valence component and a strength component. Emotions may be thought of as stronger, more specific forms of affect. Activation is an affective state. It may include various emotions (e.g., excited, happy, interested), or it may include no emotions (e.g., lethargy).

Inclusion of affect in the health behavior equation is important for three reasons. First, there is substantial evidence that cognitive mediating variables (e.g., threat and efficacy perceptions) are affected by a person's affective reactions.[24,30-33] Second, there is evidence that affective reactions to messages may have an effect on an individual's motivations.[34,35,36] For example, in a test of the role of aroused fear on behavioral intentions, Witte found that fear (an emotion generated by a message about AIDS) had a direct effect on adaptive behavioral intentions, independent of cognitive perceptions about personal susceptibility or AIDS severity.[14] Finally, it may be that prior studies of health communications have found little influence of emotional content because they have measured a too-limited spectrum of the affect construct. The vast majority of studies have limited themselves to measures of anxiety or fear of the subject health threat.[19,27] Such methods may not capture the full role of affective reactions because they neglect related emotions like guilt, empathy, or anger. Recent investigations of prosocial, affect-arousing messages (including AIDS prevention) have used broader arousal measures than have commonly been used in health communication research. Briefly stated, these studies used general measures of (a) the valence and (b) the strength of affective responses to messages. They found support for models that reflect a more prominent role for affective reactions as predictors of both cognitions and behavioral intentions. In particular, negative affect (e.g., tension, scared) was a useful predictor of health-related cognitions and intentions.[37,38,39]

Our modified PMT model is depicted in Figure 2. In it, we propose that the four persuasive message constructs have an impact on negative affect. The affective mediating variables (negative and positive affect) will combine with cognitive mediating variables (perceived threat and efficacy) to affect protection motivation, or behavioral intentions. The model also predicts that the affect variables will have an impact on protection motivation directly. The influence of individual differences between subjects (e.g., age, work experience) on both affects and cognitions is also predicted by our model.

The prominent role accorded affective reactions is not meant to diminish our estimation of the importance of the previously discussed message constructs (again, see leftmost part of Figure 2). Because the primary purpose of this article is to describe the process of

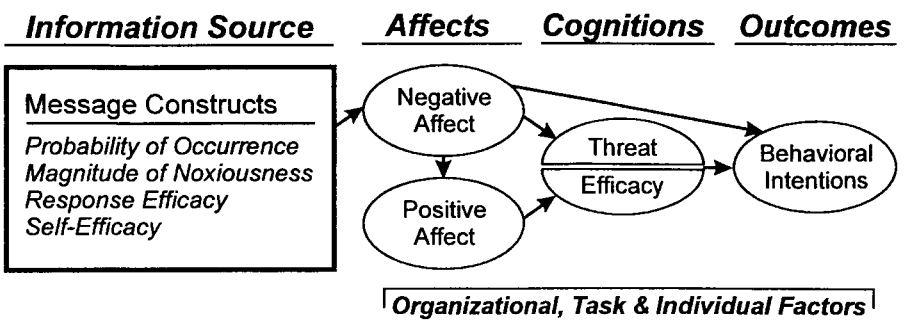

Figure 2. Model for UP training curriculum.

operationalizing these message constructs, we will forgo a discussion of the hypotheses based on our model. Instead, we now turn to a description of how theoretical constructs were used to guide the making of videotapes for in-hospital training.

MAKING VIDEOTAPES TO OPERATIONALIZE CONSTRUCTS

Video Production/Study Site

The training videotapes were produced in the same hospital in which we eventually collected data about their effectiveness among staff members. Consequently, some staff members who worked on and even appeared in the videotapes were part of the subject pool for the study of the training's effectiveness approximately one year later (a biasing factor we measured). The hospital is a 450-bed, acute care, community-based private hospital located in a suburb of Washington, D.C. The hospital has been engaged in an extensive effort to revitalize its safety program for about 2 years prior to the video production effort. This project was one of a number of safety programs that the hospital conceived and executed.

From incident reports, the hospital knew that needlestick injuries were occurring primarily among the nursing staff and the support services workers (i.e., laundry, central services, housekeeping, and dietary workers). Interviews with clinical staff revealed that many of them were not aware of the risks to nonclinical personnel. Therefore, it was decided that an in-house videotape would be developed that would emphasize the sharps injury risks of nonclinical personnel. The audience for the training was to be staff nurses, since (a) the targeted behavior (proper sharps disposal) was frequently performed by nurses and (b) because they represented a large (714 of approximately 2,000 employees) and accessible population for training.

Operationalizing Constructs Stage 1: Shooting the Video

Shooting the videotape was the first phase of preparing the finished tape, which would contain operationalizations of the theoretical constructs of interest. Planning the tape involved the merger of research and practical interests. Practically, it was important to

involve the hospital employees in the videotape shooting. First, employee involvement was consistent with the organizational push to involve workers in occupational health efforts. Second, the safety committee, which originally conceived the idea for a videotape, wanted to use the tape to open a communication channel directly from the "downstream" support services workers, upward to the clinical staff. They wanted to make sure that support services workers' concerns and working conditions were a prominent part of the videotape.

There were two prominent research concerns. The first concern was operationalizing the probability of occurrence and the magnitude of noxiousness constructs in the video in ways that would result in aroused negative affect. Here the practical concern of using the workers at risk in the video served the research interest too. Qualitative presentations of risk information, such as stories of individual exposures or near-miss exposures, have been shown to be more effective than quantitative (e.g., statistical) presentations of the same risk on measures of affect, how long the information is remembered, and motivation to take action.[40-43] Nevertheless, a survey by the authors of available training videotapes on bloodborne pathogen protection for workers revealed that most tapes used a quantitative approach to describe the risk of infection, with no qualitative or case study information to supplement it. A shift in emphasis toward using qualitative data in this production would provide a contrasting instructional method for evaluation. Also, using actual workers (rather than actors) was expected to add to the perceived credibility of the video production, since task-related behaviors (with which they were familiar) were the focus. Speaker (or actor) credibility has been shown to be an important predictor of persuasion in communications research.[44]

The second research concern was to use the replicability of the video medium to its best advantage. Videotape, although not as lifelike as a trainer's presentation, provides a consistent presentation of information. This helps to reduce some confounding message factors. In live training presentations, each trainer has personal teaching preferences and special talents that they use situationally to maximize results. In addition, interactions with trainees vary from session to session. When comparing sessions, it often becomes difficult to determine what caused differences on outcome measures. This is not to say that video eliminates message confounders (e.g., size of screen, picture quality, sound playback level), only that there may be fewer of them. By using video, and by using it for more of the training session rather than less, we could be more sure that the training would be delivered relatively consistently.

However, using video for most of the training session had drawbacks. First, it meant that there would be little or no opportunity to provide practice time. Evidence has shown that one of the best ways to teach a procedural behavior (e.g., UP) with training is to provide opportunities to practice the behavior and receive feedback.[45] Second, it meant that the video should have a "stand alone" quality to it (i.e., it should have a planned flow, a beginning, a middle, and an end). More than just operationalizing constructs, the video would have to arouse and sustain interest over a period of time as first one construct and then another were operationalized.

In view of these constraints, a documentary style was chosen for the video production as best fitting these overall practical and research requirements of using qualitative risk information to operationalize the constructs of interest. The videotapes would be contrived to have a flow in order to sustain interest. That is, the tapes would have an identifiable opening (e.g., with music and a title), middle (e.g., presentation of information about the threat and about UP), and end (e.g., with music reprise and review points). A major limitation of the production would be the absence of planned practice time in the

Table 1. Examples of Interview Content by Job Category

Job Category	Interview Content Area	Relevant Message Construct
Support services workers	Sharps injury experiences and feelings about those injuries	Probability of occurrence, noxiousness of event, empathy- and fear-arousing information
	Factors that they believed contributed to the injury (e.g., careless medical personnel)	Guilt-arousing information
Hospital managers	Workload at the hospital	Self-efficacy (i.e., the organizational barriers to compliance will be controlled)
	Responsibilities of hospital management to protect workers from injuries	
Safety specialist	National HCW needlestick epidemiology	Probability of occurrence
	Needlestick problem in the broader context of hospital safety issues	Probability of occurrence, noxiousness of event
	Sharps injuries that resulted in infections	Probability of occurrence, noxiousness of event, empathy- and fear-arousing information
	Technology and methods to prevent needlesticks	Response efficacy depictions
	Factors that influence UP compliance	Self-efficacy depictions
Nurses	Sharps injury (or near-miss) experiences	Probability of occurrence, noxiousness of event, empathy- and fear-arousing information
	Workload, hazards (other than sharps) at work	Self-efficacy (barriers to compliance)
	Effectiveness of sharps disposal units, other UP	Response efficacy depictions
	Importance of UP compliance	Self-efficacy depictions
	Organizational factors that contribute to sharps injuries	Self-efficacy depictions (barriers to compliance)

training session. In addition, a quasi-experimental design was chosen for the evaluation study. That is, we decided to compare the effectiveness of an available, commercially produced tape to our own production. The commercial tape, selected by an expert training panel for its accuracy and quality, used a preset narration, no worker interviews, and only quantitative risk information. We also decided that if we gathered enough information in our videotaped interviews with workers, we would make more than one videotape, and use one to emphasize qualitative risk information (again, for comparison purposes).

A script was prepared to serve as a general guide for videography. It indicated which job category of worker would cover each of the theoretical constructs. Whenever possible, staff who had experienced needlesticks at work were scripted to be interviewed about the circumstances of their sharps injury (susceptibility information) or how they felt about the injury after it happened (magnitude of noxiousness information). To increase message credibility, it was planned that the workers' own words, unscripted and unrehearsed, would be used to operationalize constructs. Table 1 gives an overview of the planned interview content for the tape. In addition, the script called for video to be shot of various

work scenes (to demonstrate workloads, a barrier to compliance) and UP practices (to model compliance behaviors). Graphics were scripted to mark different segments of the tape and to summarize recommended practices. Interviews with managers were planned to provide evidence of organizational commitment to reduce injuries.

Seventeen staff employees—approximately half clinical workers and half support service workers—consented to be videotaped. They were selected on the basis of their (a) job assignment, (b) needlestick history, and (c) time constraints of both the production team and the interviewee. In addition, nine management-level employees were taped. The managers were recruited on the basis of their positions as representatives of either support services or nursing activities, or on the basis of their expertise in infection control and safety. Both managers and support services workers were selected and preinterviewed prior to the videotaping of the final interview. Approximately 25 additional employees were taped as they performed their jobs. Video performance releases were signed by everyone who consented to be taped.

The interviews were focused but fairly unstructured to allow workers to reveal their experiences, attitudes, and feelings in ways that would seem most genuine to other workers on a television screen. A taped interview is not a natural conversation-inducing setting. Extra lights, taping equipment, and video production personnel can inhibit candid exchanges with workers. On the other hand, many questions were intended to elicit information about the specifics of the workers' jobs—something most people can talk about relatively easily. Often interviews went in different directions depending on which content areas the worker seemed more inclined to add something from his or her own experiences. For example, some workers who experienced needlesticks had more comments about the effects on their family. Others seemed to have more thoughts about their anxieties about follow-up medical protocols.

Operationalization Stage 2: Editing the Video

A total of 6 hours of raw videotape footage were collected over 4 days of shooting. Given that the finished tape was planned to be 20 minutes in length, 6 hours of original footage represented a "shooting ratio" of approximately 18 to 1, a fairly common ratio for documentary video production. Finding the 5% to 10% of footage that would make an effective training presentation was time consuming. It is not unusual for a single coherent thought that takes a few seconds in the final video production to be expressed in fragments over several minutes in the original interview. The selection and juxtaposition of images and sounds to operationalize the theoretical constructs and make a coherent overall training tape is mostly accomplished in the editing process, especially when using a documentary video production style that relies on unrehearsed interviews.

In the first stage of editing, all of the footage was cataloged. That is, each distinct camera view or complete verbal thought was timed and described in terms of both its visual and aural content. Because a large percentage of the footage consisted of employee interviews, cataloging involved recording who was speaking, what was said, and how long they took to say it. A brief example from the interview conducted with the hospital plumber follows, with time of each utterance shown in brackets:

Plumber: [description of job duties]. [39:20]
Plumber: I have access to all areas of the hospital . . . [39:50]
Plumber: I average 2-3 toilets per day [unstopping them]. [40:10]

Plumber: I have to clear sinks, sometimes large sinks. [40:20]
Plumber: . . . because people tend to throw things in them that they shouldn't . . . [40:30]
Interviewer: Have you ever been injured while clearing drains? [40:45]
Plumber: Yes, I have been. [40:50]
Interviewer: Tell me what happened. [40:55]
Plumber: The first time I got stuck with a needle was while I was clearing a drain in the parking lot . . . [41:00]

Catalog notations averaged one for every 10 seconds of raw footage, yielding a catalog with over 2,000 entries.

To make the tape, each video segment was categorized as to what theoretical construct it might help operationalize (e.g., probability of occurrence, self-efficacy), or by its content (e.g., hospital new needle purchase rates) if no construct was obviously indicated. Notations of the emotional tone (e.g., ironic, maudlin, angry, anxious) were also made for many of the segments. Then, lists of segments were regrouped by their construct category. For example, all the segments that dealt with HCWs' susceptibility to occupational bloodborne pathogen infections were grouped together.

This does not mean that specific video segments were classified as representing an entire theoretical construct. It is more accurate to say that a segment was deemed an indicator of one or more dimensions of a construct.[46] An example of the way the video segments were classified may be found in Table 2. It summarizes the video segments that were used to operationalize the message constructs of probability of occurrence and magnitude of noxiousness in the video about downstream workers. The segments are listed (with their running time in seconds) in the column on the right-hand side of the table. Each segment is further associated with a particular group of HCWs: a subgroup of support services workers, the overall group of support service workers, nurses, or HCW overall (middle columns of Table 2). Each of these groups is a dimension of the two basic constructs. These dimensions facilitated the mixing of segments in the final program in such a way that an impression of overall risk was created.

During editing, it became clear that there were enough different segments that operationalized dimensions of both probability of occurrence and magnitude of noxiousness to make two different videotapes: one emphasizing the needlestick risks of support services workers and a second emphasizing the risks to nurses themselves. Both tapes were completed in order to compare the effects of these two different operationalizations of the message constructs on the outcome variables. For the support services workers tape (eventually titled *Not Only Our Patients, Not Only Ourselves*), the editor tried to use segments that would elicit audience sympathy for the support services workers. We thought this would lead to negative emotions like guilt and shame among nurses about their neglect of proper sharps disposal practices. In the second tape (eventually titled *I'm at Risk*), the editor mixed segments containing exposure experiences of nurses with segments from the safety specialist interview. The latter segments involved details from cases in which nurses (and a physician) in other health care facilities actually contracted HIV-1 from occupational exposures. The anticipated effect was that negative emotions such as fear and anxiety would result. Although both tapes were hypothesized to raise negative affect, they would obviously do it in different ways. Note that Table 2 has an illustrative purpose and it reflects only the segments that were chosen to operationalize constructs in the finished tape, *Not Only Our Patients, Not Only Ourselves.*

The segments chosen to operationalize the efficacy constructs for both tapes were very similar, although not identical. Segments from the infection control specialist and the

Table 2. Operationalization of the Noxiousness of Event and Probability of Occurrence Message Constructs

Construct Dimension	How Operationalized in Video	Duration
Message construct: Noxiousness of event		
Overall	HIV risks	(:08)
	A needlestick may be a death sentence	(:04)
Support services workers		
Dietary workers	Anxiety of workers about possible exposures	(:07)
Laundry workers	Personally felt/family-felt anxiety	(:12)
Maintenance	Personally felt/family-felt anxiety	(:16)
Housekeeping	Personally felt/family-felt anxiety	(:13)
Message construct: Probability of occurrence		
Overall	Needlestick epidemiology (national)	(:23)
	Needlestick epidemiology (local)	(:28)
Nurses	Workload	(:57)
	Stress	(:14)
	Distraction	(:10)
	Urgency of care	(1:05)
Support services workers		
Overall	Needlestick epidemiology	(:15)
	Individual needlestick experiences	(:26)
Dietary	Workload	(:17)
	Needlestick risks	(:24)
Clean room	Workload	(:40)
	Needlestick risks	(:27)
Laundry	Workload	(:06)
	Needlestick risks	(:25)
	Needlestick experiences	(:50)
Maintenance	Workload	(:07)
	Risks	(:21)
	Needlestick experiences	(:41)
Housekeeping	Needlestick risks	(:23)
	Needlestick experience	(:22)

safety specialist interviews about the effectiveness of sharps containers were used in both tapes. The infection control specialist talked about the recent replacement of sharps containers throughout the facility with "larger boxes that have a wide mouth and a straight drop," three convenience- and safety-enhancing features. She also discussed the hospital-wide adoption of a needleless intravenous therapy system as playing a role in the reduction in needlestick incidence rates. The safety specialist talked about the fact that "sharps containers are great but they have to be used and they have to be emptied on time." Segments were selected for both tapes from interviews with nurses, in which they discussed how the increased number of sharps containers in the hospital not only made their jobs easier, but safer. Segments in which nurses described how the needleless intravenous system contributed to safety were also selected.

Operationalizing self-efficacy in media productions frequently involves modeling the target behavior(s).[47] A number of visual shots of UP compliance activity were selected to operationalize this construct. Views of used syringes being deposited in the sharps

Table 3. Operationalization of the Response- and Self-Efficacy Message Constructs

Construct Dimension	How Operationalized in Video	Duration
Message construct: Response efficacy		
Positive aspects	"Needleless IV system was installed to reduce use of needles"	(:16)
	"New (and improved) needle disposal containers were installed"	(:19)
	"Since introduction of the IV system and the new sharps containers, injuries have been reduced"	(:24)
Negative aspects (barriers to compliance)	"Disposal containers have to be accessible and emptied on time"	(:10)
	"In some situations you can not use the needleless system"	(:06)
Message construct: Self-efficacy		
Positive aspects	"There are lots of resource people available [on compliance issues]"	(:13)
	"It's up to the organization to provide support and training for UP"	(:12)
	"Staffing levels can be a problem, although not here"	(:11)
	Scenes of proper sharps disposal	(:08)
	Scenes of proper biohazard trash disposal	(:13)
Negative aspects (barriers to compliance)	"Increased stress from shouldering more responsibilities"	(:22)
	"Workload"	(:22)
	"There are situations when you just can't take all the precautions"	(:31)
	"In a code situation [many UP are temporarily ignored]"	(:19)
	"Job pressures (e.g., starting an IV on a baby)"	(:31)
	"We have to provide a lot of care and education in a short time"	(:13)
	"Distractions in the operating room"	(:05)
	"Habits of workers are hard to break"	(:28)
	Scene of improper sharps disposal in patient care setting	(:25)

disposal containers were used. Views of glove and gown use and biohazard waste disposal were also used. Audio from selected interviews was used as voice-over for these shots (e.g., a segment from the safety specialist in which she states that UP compliance must be a high priority).

However, as stated, these behaviors are common behaviors for which self-efficacy perceptions were assessed to be already high under ideal circumstances. That is, nurses felt that UP compliance was easy as long as they had time. In the interviews it became clear that barriers to UP compliance was a dimension of self-efficacy perceptions. Consequently, that material was also used to operationalize the self-efficacy message construct in both tapes.

There is a substantial body of research that supports this operationalization. That research has shown the value of "inoculating" audiences against persuasive attempts to discourage the desired behavior.[48] These inoculations are presentations of reasons why a recommended behavior may be difficult to accomplish or be otherwise inadvisable. Acknowledging the commonly cited difficulties of health behavior compliance can reduce reliance on these difficulties as excuses for noncompliance and may increase self-efficacy for compliance. The operationalization of the efficacy constructs for both tapes is summarized in Table 3.

The final step in the editing process is to make a meaningful videotape using the segments selected to operationalize constructs. This does not mean just editing one selected statement after the other until they are all included. To achieve an overall coherency, pace, and rhythm requires careful attention. Table 4 summarizes all the segments, in order of appearance, in *Not Only Our Patients, Not Only Ourselves*. A brief statement of the issues covered in the program is followed by segments on the risks to nonclinical workers from misplaced needles. The response efficacy, self-efficacy, barriers to compliance, organizational support, and behavioral recommendations follow. Within this flow, the editor placed brief reprises of previously introduced constructs and previews of constructs to be more fully introduced later.

Table 5 summarizes the content differences across all three tapes used in the study. The tapes were pretested with small groups of nurses in a large urban teaching hospital in the midwestern United States before use in the main study. We now turn to a brief discussion of how these training tapes were evaluated.

Evidence of Message Construct Operationalization Success

Because study hypotheses center on differences in affective, cognitive, and behavioral outcomes expected to result from different levels of the message constructs, confirmation that the tapes used in this study are associated with different levels of affective arousal is an important prerequisite to hypothesis testing. This is known as a manipulation check. It tests whether there are any (theoretically relevant) differences between treatment conditions. In the evaluation study, 311 nurses and other staff members completed a 56-item pencil-and-paper survey immediately after seeing one of the three quasi-randomly assigned tapes. Demographic data, negative and positive affect, cognitions, and behavioral intentions were measured.

Although a full analysis of the data is not yet available, preliminary results of the manipulation check of treatment conditions are available. From data collected using the PANAS scale[49] to measure respondents' self-reports of affective response felt during the tape, it appears that there are differences across the tapes in the amount of negative affect they aroused, $F = 16.92$, $df = 2, 281$, $p = 0.0001$. Follow-up comparisons of treatment means for the negative affect measure indicated that both tapes produced for the study aroused greater negative emotions than the off-the-shelf tape. There was no difference on this measure between the two tapes produced for the study. Similarly, there appears to be a difference between all three tapes when a subscale of guilt was used, $F = 5.21$, $df = 2, 285$, $p = 0.006$. The tape concerning the support services workers' risks aroused more guilt emotion than either the tape concentrating on nurses' risks or the off-the-shelf tape. There was no difference between the latter two tapes. It appears that the study manipulation was moderately successful. In addition, there were no differences across tapes on a subscale of interest and attentiveness, $F = 2.17$, $df = 2, 288$, $p > 0.10$. It appears that negative emotions were more aroused in some tapes in spite of the indications that each tape had about the same interest value for viewers.

SUMMARY AND CONCLUSION

In this article we first presented an adaptation of a commonly used health message theory, PMT, to fit current empirical evidence about the importance of emotional arousal

Table 4. Sequence of Message Constructs in a Finished Training Tape

Show Segment (Duration)	Scenes	Featured Workers	Duration	Construct Operationalized
Opening (1:55)	7	Safety specialist, nurses, laundry, maintenance, central processing	(1:02)	Probability of occurrence, noxiousness
			(:31)	of event
	2	Nurses		Self-efficacy
	1	Maintenance worker	(:14)	[Empathy arousal depiction]
	1	Safety specialist	(:08)	[Recommended standard]
Where do sharps	2	Safety specialist, infection control specialist	(:42)	Probability of occurrence, noxiousness
appear? (7:32)	3	Dietitian	(:48)	of event [to support services workers]
	2	Central processing supervisor	(1:07)	
	8	Laundry supervisor, laundry worker	(1:33)	
	7	Maintenance worker	(1:24)	
	3	Safety specialist, housekeeping worker	(:58)	[Empathy arousal depiction]
Why do sharps	9	Assistant vice president, nurses	(1:01)	Self-efficacy [barriers to compliance—
appear in the	1	Nurse		organizational and job]
wrong places? (4:31)	2	Nurses	(:09)	Social norms (doctor's use of UP)
			(:21)	Self-efficacy [barriers to compliance—
				organizational and job]
	6	Safety specialist, nurses	(1:40)	Social norms (culture of sacrifice)
	3	Laundry supervisor, laundry worker, housekeeping worker	(:40)	[Guilt arousal depiction—carelessness
				is unacceptable]

Increasing proper sharps disposal (3:27)	3	Proper sharps disposal	(:08)	Self-efficacy depictions
	1	Nursing supervisor	(:12)	Self-efficacy (organizational factors)
	2	Safety specialist	(:28)	Self-efficacy (barriers to compliance individual level: habit)
	4	Nurses, infection control specialist, safety specialist, procurement specialist	(1:10)	Response efficacy
	2	Nurses	(:17)	Barriers to compliance
	3	Nurses	(:31)	Behavioral recommendation
	2	Safety specialist, nurse	(:13)	Emotional arousal (guilt)
	1	Vice president	(:32)	Self-efficacy (organizational support)
	1	Laundry worker	(:04)	Threat to SSW
Closing (:30)	1	Graphics	(:30)	Behavioral recommendations

Table 5. Summary of Videotape Differences

Tape Characteristic	Tape A (Commercially Produced)	Tape B (Produced for Study)	Tape C (Produced for Study)
Audience	BROAD (all HCWs)	NARROW (nurses)	NARROW (nurses)
Exposure route content	BROAD (many situations)	NARROW (needlestick emphasis)	NARROW (needlestick emphasis)
Organizational focus	BROAD (cues are nondescript)	NARROW (shot entirely in trainees' hospital)	NARROW (shot entirely in trainees' hospital)
Relevance of health threat to audience	LOW (all HCWs)	MEDIUM (same hospital but nonnurses)	HIGH (nurses in same hospital)
Use of probability of occurrence message construct	LOW (quantitative data only)	MEDIUM (quantitative and qualitative data)	HIGH (includes stories of occupational infections with HIV-1)
Use of efficacy message constructs	HIGH	HIGH	HIGH

in messages. This adaptation may add to an understanding of the role of emotions in health behavior change processes. Some authors have concluded that emotional arousal has no place in public health education settings because arousal is either counterproductive, unproductive, or unpredictable.[50,51,52] However, evidence to the contrary exists. Zajonc's influential conclusion that "preferences need no inferences" called attention to the unjustified dominance of cognitive explanations of behaviors 15 years ago.[30] More recently, Damasio persuasively argued that neurobiological evidence suggests that the portions of our brains that deal with our emotions profoundly color our thinking (and eventual actions).[53] He concludes that it is feelings rather than cognitions that allow us to make the sophisticated social behavior decisions that help define human existence. If that is true, then emotions must play a role in workplace safety behaviors as well. Our training evaluation study (still being analyzed) addresses that possibility.

The second part of this article described how the theoretical constructs of the modified PMT were operationalized in video training materials. In the main, we used structured interviews with HCWs to operationalize the four message constructs: probability of occurrence, magnitude of noxiousness, response efficacy, and self-efficacy. We edited relevant segments into two different videotapes that emphasized stories of HCWs' experiences with bloodborne pathogen exposures and the results for themselves and for their families. One of the tapes emphasized the exposures of nonclinical HCWs and the other emphasized the exposures of nurses.

Our description shows the complexity of operationalizing intervention constructs, especially for field experiments. For example, there were limitations to the amount and type of taped interviews with HCWs that the research team was able to collect. Some questions clearly made workers uncomfortable and were not pursued (e.g., lack of UP compliance among physicians). In addition, cooperation of clinical staff from some busy departments was limited due to workload. There were also limitations to our video editing. We did not equate our messages for length, nor did we equate the length of time devoted to each construct within a tape. When operationalizing the two threat constructs, one

might be tempted to balance evenly between susceptibility and severity information. However, in the case of bloodborne pathogens there is little need for severity information, since the effects of HIV-1 infection are so catastrophic and so well known. Consequently, susceptibility information was emphasized in this project. But the needs of the next health or injury hazard, the next workplace, and the next group of workers will require new operationalizations of the same theoretical framework. Consequently, careful attention (and documentation) of the operationalization of message constructs is necessary in order to understand message effects.

As a training tool, video, especially custom-designed video, has major advantages for operationalizing constructs in useful ways. In 18 minutes, one of the videotapes described above brought six nurses, seven downstream workers, several managers, and a safety consultant "into" training sessions. Their images and their own spoken words about their risk perceptions and their emotions were present, even though they themselves were not. Each person's segment had been edited to get at the strongest (and theoretically relevant) points. Each point was linked to the points made by others. Music and graphics added emphasis. But the versatility and precision offered by electronic media does not necessarily mean that better and more precise operationalizations will result. The temptation to compare the number of seconds devoted to a construct across treatments, both within and between studies, should be resisted. Too many other factors come into play.

For example, the limitations of our effort to operationalize concepts with videotapes is evident from Table 5. Although presented as a guide to the differences between study treatment conditions, it also may be read as a guide to confounded message manipulations. If there is a difference on outcome measures between say, tape A and tape B, will it have resulted from the targeted audience, the threat relevance, the organizational specificity, or some other difference? Although we hope to sort out these confounders to the limits of the data, there are hundreds of factors that are uncontrolled across tape conditions. This problem has existed in health message research for a long time.[54] Jackson has suggested that a change in experimental design would help solve this problem in message effects research.[55] She argues that by including a replications factor in every study (i.e., by using more than one example of every message type in an experiment), researchers could separate the variance in outcome variables that is due to differences between operationalizations *of the same construct.* Although this suggestion is useful, it may not always be possible to construct and test, say, four or five instantiations of each message factor of experimental interest. Video and other training technologies hold potential for somewhat controlling the confounding factors in messages, but that goal is so complicated as to be elusive. We may progress if we can begin to more accurately map our curricula constructions onto our theoretical models.

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