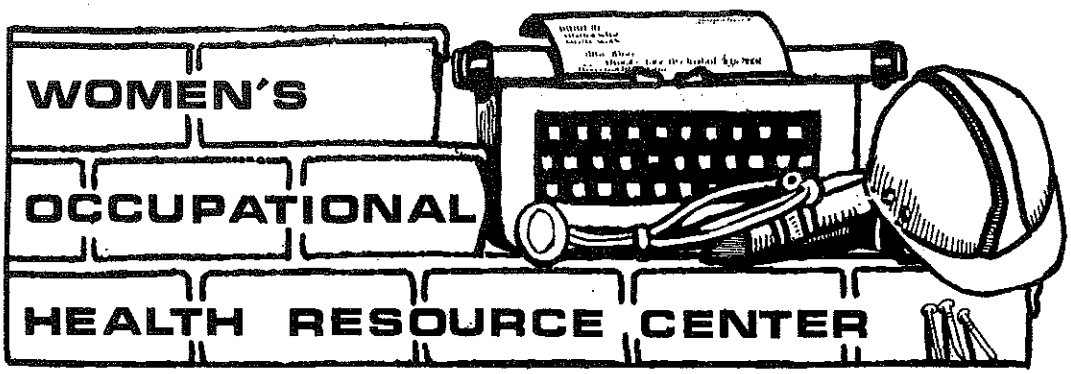


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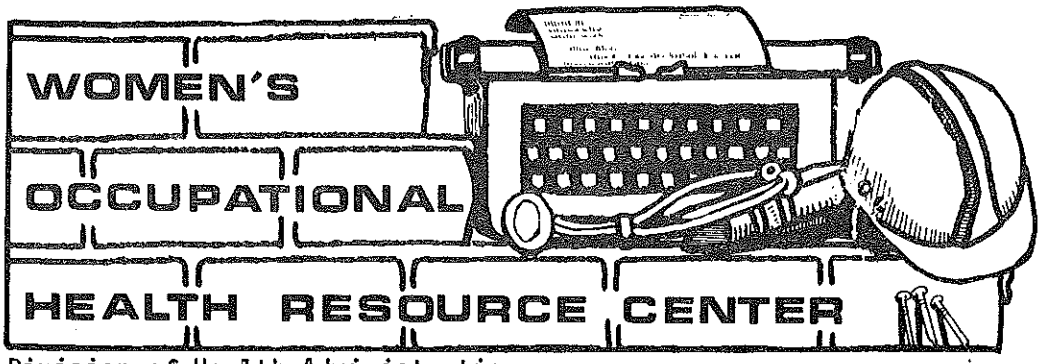


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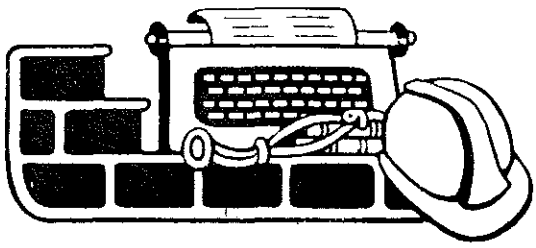

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# Occupational Safety: Why Do Accidents Happen?

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## INTRODUCTION

Workplace accidents result in the disablement or death of tens of thousands of U.S. workers annually. The high cost of these workplace accidents is an immense burden to all sectors of the American society: workers, employers and the government. The National Safety Council reports that in 1980 alone 245 million work days were lost due to workplace accidents, at a total cost to the economy exceeding $30 billion.[1] Yet even these figures fail to measure the pain and suffering of workers and their families that accompany disability and premature death, figures neglected in most cost-benefit analyses.

Despite the enormity of the problem, there is no question that as a result of improved working conditions occupational fatality rates have actually dropped in the post-World War II era. In 1937, the annual death rate from workplace accidents was 43 per 100,000 workers per year; in 1960 the rate was 13 per 100,000, a decline of 70%. Other statistics are not as encouraging. After declining for a number of years, the number of disabling injuries actually increased 29% during the period 1961-1971. Injury incidence then began to level off and started dropping in the 1970s, declining almost 20% in the years 1972-1980. This decrease in injuries is in large part attributable to engineering controls and work practice changes mandated by the newly established Occupational Safety and Health Administration (OSHA).[1-3]

What is behind these statistics? Can we predict workplace accidents? This article examines some of the ideas generated by current safety research, and sets forth some criticisms and suggestions.

Until the late 1800s, many illnesses and premature causes of death were widely believed to be the results of acts of God or chance, only indirectly related to our environment and our actions. This primitive understanding of infectious and chronic disease has succumbed to the more modern concepts of the germ theory and of the environmental and genetic factors that increase an individual's risk of contracting a given health problem. It is notable, therefore, that "accidents remain the only major source of morbidity and mortality which many continue to view in essentially extra-rational terms. 'Luck', 'chance' and 'acts of God' are all culturally acceptable explanations of accidents, although such concepts have gradually fallen into disuse in explaining the causation of disease."[4,5] Even the word accident connotes a random event or one with a significant element of chance. It is unfortunate that this attitude is still held by many workers, employers and health and safety professionals because it limits their ability to prevent workplace accidents. In this paper we will demonstrate that accidents are not the result of luck or chance; their occurrence is closely associated with and to some extent predictable by a wide variety of environmental factors in the workplace. Accidents will only be prevented when these factors are addressed and adjusted. The occupational health nurse can play a major role in this process.

## THE MYTH OF THE "ACCIDENT-PRONE" WORKER

There are numerous theories currently held by both safety experts and the public concerning the cause of accidents. As we shall see some are based on direct studies, some are based on studies which were later shown to be false and some are

# Guest Editorial

## Safety: An Issue Whose Time Has Come — Again

The first decade plus of the Occupational Safety and Health Administration has seen a growing recognition, indeed a sense of urgency, about controlling chemical exposures in the workplace. This trend is understandable. Post World War II civilization can easily be characterized as the Petrochemical Age, an era which ushered in increasing awareness of the potential danger associated with many of the more than five million natural and synthetic chemicals registered today.

Chemical hazards have been given priority in recent years. In the health and safety movement, safety seemed almost to drop out of the picture. To many of us, it felt as if we were in a tug of war with chemical hazards on the one end of the rope, and safety hazards on the other. The struggle is not difficult to analyze. At the time of passage of OSHA, a large number of the practitioners in the field were concerned with safety and accidents, the obvious injuries that occur at work. Chronic diseases such as cancer and pulmonary disease, are more difficult to detect and recognize and were not the main item on anyone's agenda.

For many workers, their representatives and health and safety activists, occupational illnesses were systematically denied recognition by state, federal and company officials. So the tug of war began.

In 1982, this struggle, as so many actual wars, is not only unnecessary but is detrimental and shortsighted — but it was a struggle I believe had to be. Recognition of chemical and physical hazards, both in the workplace and in the general environment was needed. There is still much more to learn than we already know. But it is also time to "reemphasize" the importance and relevance of eliminating safety hazards from the job.

Most knowledgeable people agree that the old "blame and victim" approach to safety is wrong. Unsafe conditions breed most accidents. In this issue of OCCUPATIONAL HEALTH NURSING we have covered some aspects of safety. We describe safety hazards in the hospital and the office, and focus in on a controversial new worktool: the video display terminal. We discuss the effects of safety hazards on worker mental well-being and provide some historical considerations and compensation aspects of the issue. We look at personal protective equipment and some of the problems that can arise from its misuse or poor fit. We have only skimmed the surface of safety, neglecting completely many of the hazards in traditional jobs thought of as "unsafe."

What is the message? It is not a question of safety *versus* health but of safety *and* health. An integrated, whole-person approach is needed toward both the workplace and the worker. Safety, job design, chemical and physical hazards, mental stressors, and for women workers, with their many social roles, social support like childcare, are all necessary ingredients in the recipe for a safe and healthful workplace. Only in this way can we achieve the goal of providing every working man and woman a workplace free from recognizable hazards. Indeed, we might even be on the road toward making work a positive experience in the lives of all Americans.

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lacking an empirical base.

Perhaps the most well known of these theories of accident causation is that of the "accident-prone" worker. This theory states that there are some workers who, because of individual psychological and behavioral characteristics, are more likely than others to be involved in accidents. Unfortunately this notion of accident proneness is widely accepted by managers, workers and the public. What is not generally known, however, is that scientific and safety experts have repeatedly shown that the theory of "accident proneness" is false and therefore contributes little to prevention of workplace accidents.

The theory of accident proneness stems from studies of accident frequencies conducted by Greenwood and others during the early 1900s. Greenwood investigated accident rates in munition factories and other worksites and demonstrated, using statistical tests, that an abnormally high proportion of all accidents was seemingly caused by only a small percentage of the workforce.[6,7] The implication of Greenwood's findings was that if these "accident-prone" workers could be identified and excluded from hazardous jobs, injury incidence would be markedly reduced. Since Greenwood's studies, however, several authors have demonstrated that the majority of his results were an artifact of faulty study design. Greenwood and his colleagues used a static, mechanistic model to describe what we now know is a complex and changing situation involving the interaction of many variables. As noted by Robert Sass and Glenn Crook in their excellent critique of "accident proneness," Greenwood ignored factors such as heat, noise, illumination, toxins, improper training, inexperience, fatigue, shift, the speed of work, the variability of tasks performed, and the type of production incentives used, all factors which have significant impacts on accident rates. Further, Greenwood did not differentiate between minor and severe injuries nor take into account the influence of sustaining one accident on a individual's subsequent accident experience. Finally, all accidents were aggregated regardless of the job the worker was performing.[8,9]

The theory of "accident proneness" has been disproved in other ways. Many investigators have attempted to identify either psychological or behavioral characteristics that predict accident proneness; not a single investigator has succeeded.[10] At most, if there is a phenomenon of accident proneness it is a temporary characteristic caused by transient external or internal influences on worker behavior.[11] Therefore, we believe that any attempt by safety experts or personnel managers to screen out "accident-prone" workers is doomed to failure and a waste of safety and health resources.

One result of the widespread belief in this theory, however, has been "victim blaming." If some workers are identified as the primary cause of accidents, there is less of a need to focus on the dangerous nature of industrial work. One example of this approach is H.W. Heinrich's study of accident causation published in his widely-used text, *Industrial Accident Prevention: A Scientific Approach,* originally published in 1931 and subsequently republished several times. After investigating thousands of accidents, Heinrich concluded that 88% of accidents are caused by people, 10% by physicial conditions and 2% by acts of God. Although Heinrich included management mistakes as well as those of labor in the "people" category, his work has been widely quoted as signifying that "workers are responsible for 88% of all accidents." While Heinrich's cataloging approach is of little use in examining accident causation, other studies using similar methods have found contradictory results. An examination of construction accidents by Hagglund, for example, found that unsafe conditions were responsible for more than half the accidents studied and unsafe actions by individuals were responsible for no more than 30%.[12]

There are several specific personal factors which are thought to influence workplace accidents, such as experience, age and gender. As we shall see, experience indeed plays a major role, age may be an important contributing factor and gender does not appear to influence injury rates.

## AGE VS. EXPERIENCE

The best-studied of these factors is age; younger workers are at far greater risk of suffering an injury than older workers, although older workers are more likely to be permanently disabled as a result of injuries. This is illustrated by a 1977 Bureau of Labor Statistics examination of the age distribution of injured workers' compensation cases. Older workers, while suffering fewer accidents, are at far greater risk for more severe accidents than younger ones.[13] It is not surprising, therefore, that the average monetary settlement resulting from occupational injury increases with age. Of the cases studied, indemnity compensation for injured 16- to 17-year-old workers averaged $593, only one third of the $1,637 paid to injured workers age 65 or older. The average medical payment for the two groups was $318 and $609 respectively.[13,14]

The major factor contributing to the high frequency of injuries among young workers is not youth, however, but inexperience. Another Bureau of Labor Statistics study found that, among men, more than 30% of all injuries take place within the first six months of service, regardless of age. For women, the figure is only slightly lower. Thus, in every age group, new workers suffer far higher injury rates than their experienced counterparts. Since a greater proportion of younger workers are inexperienced, accident rates in this group are correspondingly high.[15] In a recent detailed analysis of workplace accidents among teenagers Drucker and Gruenbaum again confirmed that the contribution of lack of experience appears to be a more important factor than age.[16]

## GENDER

A final individual characteristic that has been thought to be associated with risk of injury is gender. Many people believe that women are less likely to be involved in accidents than men and a superficial glance at the

accident statistics and literature supports this view. Women suffer from fewer workplace injuries than men. However, recent analyses have shown these data to be a result of employment patterns, not differences in injury frequency. Women are employed in less hazardous industries and, as noted by Dillingham, "differences in occupational distribution are known to account almost fully for the observed differential in male/female injury rates." In every instance examined so far, men and women employed in the same jobs have comparable rates of injuries.[17,18]

## WHAT DOES CAUSE ACCIDENTS?

The most recent advances in the prevention of workplace accidents have come from the identification and examination of hazards in the work environment. As a result of hazardous work environments, some industries have injury rates far higher than others. It comes as no surprise, for example, that lumber mill workers suffer more accidents than bankers. Equipment that moves rapidly and cuts heavy logs is obviously more dangerous than many office machines although workers in both workplaces may be at risk for injuries. In 1980, construction workers had an injury rate of 15.5 per 100 full-time workers; one in every six workers was injured in the course of a year's employment. This is almost twice the rate of workers in wholesale trades, whose rate was 8.1 per 100, and more than three times the rate of service workers (5.1 per 100). Other high hazard industries are lumber and wood products (18.4), frabricated metal products (18.0), food products (18.1) and furniture and fixtures (15.6). The national private sector average is 8.5 per 100 full-time workers.[2]

There is little question that a major decrease in accidents occurring in hazardous workplaces in the first half of this century followed significant improvements in the workplace environment. Recent research has led us to a greater understanding of the specific environmental factors that contribute to accidents. We believe that continuing to modify the work environment will be the most efficient and effective way to further reduce accident rates. Several additional environmental factors that contribute to accidents and methods of prevention are discussed below.

## ERGONOMICS

Ergonomics, the science of worker-machine interactions, is a tremendously useful tool in studying the factors contributing to accidents and developing preventive techniques. This field, also known as Human Factors, has made important advances in the redesign of job tasks in a way that insures they can be performed safely. By applying principles of biomechanics and anthropometry to the design of the workplace, ergonomists have developed new types of work stations, machinery and redesigned tools, all factors that previously contributed to workplace injuries. Among the most famous examples of tool redesign are the pliers and paint scrapers designed by Erwin Tichauer. Earlier models of these traditional handtools were responsible for epidemics of carpal tunnel syndrome in workers; the redesigned tools have almost eliminated this problem.[20] Engineering innovations have also been applied to accident prevention with results that are equally striking. For example, construction crane cabs were modified to widen the operator's field of vision, preventing many accidents from occurring, Similarly, truck handbrakes were redesigned to enable drivers to apply them more quickly and more easily in an emergency situation.[21]

More familiar engineering innovations that have become widely utilized in industry are new forms of fail-safe machine guards, lockout devices and two-handed control systems. The basic purpose of each of these devices is to ensure that machinery will not run when a worker is making adjustments, changing materials or preparing for the next task. Unfortunately, increased production pressures often lead to short cutting these protective devices and safe work practices.[22]

## PRODUCTION DEMANDS VS. SAFETY

It is not surprising that production demands and the resultant increased speed of work has had a major influence on injuries. Workers under pressure tend to make a greater number of mistakes and are less likely to take the precautions necessary to reduce accidents. The best-known study of the relationship between production demands and accidents involved 5,000 Swedish ironminers. As a result of a strike in 1959, these miners obtained for the first time a fixed salary instead of the piece rate system that previously governed their wages. The resulting drop in both injury incidence and severity was dramatic; severe accidents were reduced by over 80% within two years.[23]

The contribution of worker fatigue to injury rate also appears to be associated with the production demands and speed. While there has not been a study which has directly related fatigue to increased risk of accidents, many investigators have noted that accidents vary in frequency depending on time of day, day of week, and time of year. As analyzed by Surry, these fluctuations vary from study to study, most likely resulting from differences in tasks, conditions and individuals. However, Surry was able to identify several stable trends in the daily frequency of accidents. In general, accidents increase by 50% to 100% from the beginning of the morning shift to a peak between 10:30 and the lunch break, after which the rates fall again. Accidents then rise until the middle of the afternoon when they decline or level off until the end of the day shift. It is likely that these fluctuations are the result of interactions between worker fatigue, boredom, hunger, and changing work conditions.[21]

## TOXIC CHEMICALS, NOISE AND TEMPERATURE

Recent data suggest that the presence of toxic chemicals, noise and heat may also be responsible for higher accident rates. These environmental factors are thought to decrease a worker's ability to respond quickly to hazardous conditions. For

example, an investigation of workers exposed to lead, a common industrial pollutant, found that these individuals had decreased capacity to perform neuro-muscular tasks and suffered a decline in hearing acuity.[24] Similarly, a group of mercury-exposed workers had atypical electromyograms, frequent arm tremors and fumbling movements in hand coordination compared with a control group. Once removed from mercury exposure, neuromuscular response improved.[25] Neither the groups exposed to the mercury nor the lead exhibited any clinical symptoms of heavy metal intoxication. Finally, a study conducted on volunteers exposed to anesthetic gases at levels commonly found in the hospital operating room environment, measured the subjects' short term memory, visual perception and reaction time when performing a combined audiovisual task. The findings suggest that the subjects' ability to perform these complex tasks was significantly reduced by exposure to trace levels of anesthetic gases.[10]

It is quite possible, therefore, that many such sub-clinical symptoms arising from exposure to toxic chemicals contribute to accidents among workers. We believe that the occupational health nurse should pay increased attention to levels of workplace chemical exposures when investigating the causes of accidents.

Physical agents also have a detrimental effect on worker performance and therefore influence accident rates. Worker efficiency decreases markedly with heat and cold; this effect, best described by a U-shaped curve, has been well documented in numerous studies. One study noted a 25% accident increase with every 5° F rise or fall from an optimal temperature, mediated by humidity, airflow, and acclimatization. With increased heat, workers suffer from fatigue, lose the ability to concentrate, and may experience subjective reactions that are related to higher accident rates. Reaction time and manual dexterity decrease markedly in cold environments as well, resulting in poor manual performance as well as increased frequency of accidents.[21]

Exposure to noise is also thought to cause deficits in performance by disrupting feedback that workers rely on to prevent accidents. One study suggests that accidents rates increase with workplace noise levels, but further investigation must be undertaken in this area before a clear association is identified.

A final environmental factor that has been known to play an important role in determining accident rates is the quality and activities of the supervisory personnel. The willingness of a supervisor to support and encourage safe work practices, even when in conflict with the demands of production, can have an important impact on the avoidance of accidents. Unfortunately, very few studies have directly examined this problem. One notable exception is a report of the British Postal Service that describes a 50% reduction in lost workdays due to injury following a major change in management and the introduction of supervisory personnel who were perceived as more sympathetic to the needs of the workforce.[26]

## SAFETY CAMPAIGNS OR PREPLACEMENT TRAINING?

Many companies conduct continual safety campaigns exhorting workers through posters and signs to prevent accidents. It appears that while campaigns to encourage or discourage very specific actions have a positive effect on injury reduction, the more general campaigns of the "think safety" variety are not at all effective in reducing accidents.[21]

It appears, on the other hand, that preplacement training has an important impact on the reduction of accidents in the period immediately following placement, the period of greatest risk. Lack of formal training, however, apparently has little effect on long-term accident rates, perhaps because untrained workers are trained by their colleagues or train themselves on the job.[21,27] Thus, a clear lesson to be learned from these studies is the importance of training workers assigned to new tasks. A supervisor who introduces or transfers an employee to a new assignment without adequate training is raising the probability of a workplace injury. We believe that the resources devoted to general safety campaigns should be directed toward specific hazards alerts or better still towards preplacement training.

## SUMMARY

The implications of these studies are clear; workplace injuries result primarily from workplace hazards. There is no such thing as an "accident-prone" worker. There are rather environmental and other factors which decrease a workers ability to prevent accidents. Injuries will therefore remain part of the high price paid for industrial production until changes are made in the work environment eliminating the cause of accidents. In order to do this, industry must:

1. Introduce engineering controls and ergonomic alterations to eliminate unsafe conditions.
2. Place safety above production demands so that no worker is subtly or overtly forced to take short cuts that increase their likelihood of injury. In many instances this might necessitate eliminating the piece-work system and paying a regular wage.
3. Reduce exposures to chemicals and physical hazards present in the workplace that decrease ability to prevent accidents. Jobs should be designed so that workers are not excessively fatigued and therefore more likely to be injured.
4. Provide adequate safety training for newly hired or transferred workers.

## ACKNOWLEDGMENTS

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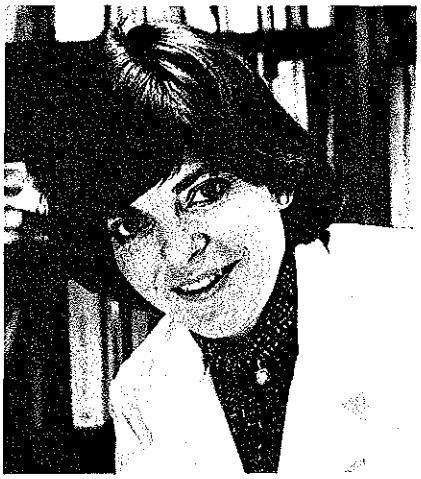
# Safety in the Health Care Industry

The health care industry is one of the major employers in the United States. More than four million people work in hospitals, nursing homes, clinics and other institutions which provide health services. Despite the dedication of these institutions to care and healing, health care facilities can be dangerous places for the people who work in them. Hazards can include chemical (e.g., anesthetic gases), physical (e.g., radiation), psychosocial (stress and shift work) and safety problems. In this paper we focus on the safety problems, a particularly important area, since the National Safety Council estimates the injury rate among hospital workers to be twice that of other service industries.

Accurate statistics on injuries in the health care industry, as with other industries, are not readily available. Virtually no institution records, reports or receives notices from employees of every needle-stick or back strain that occurs on the job. Employees themselves are often too busy or untrained or have become so accustomed to these accidents that they neither report accidents nor seek treatment for them in employee health services. (It may also be that some employees are hesitant to avail themselves of employee health facilities for fear of poor job performance ratings.)



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Some relevant data on accidents are available from our Medical Center. Lewy[1] reports the following breakdown among the total incidents reported: contusions and bruises, 25%; back injuries, 16%; lacerations, 12%; sprains and strains, 10%. This is a similar pattern to accidents reported elsewhere.[2]

Lewy also found that nurses account for 60% of the reported incidents but only represent 33% of the hospital workforce. Similarly, kitchen workers account for 19% of the incidents which represents 10% of the workforce, seeming evidence that direct patient contact and patient service areas are at greater risk for injury. These conclusions are not firm, however, since it is not known whether the differences in reported rates are attributable to an actual greater frequency of incidents, to a greater likelihood to report, or to data which have not yet been corrected for nature of work.

A multitude of hazards exists in the health care setting, ranging from fire, explosion and electrical shock, hazards similar to other industries, as well as to risks more peculiar to health care, such as needle-stick wounds and patient-lifting strains.

*NEEDLE-STICK WOUNDS*, and other puncture injuries from sharp instruments, are commonplace occurrences. They can occur when administering a drug, when drawing blood or when a needle has been inadvertently or carelessly tossed in with bedding or non-sharp disposables. Although it may be tempting to equate a simple needle-stick injury to a paper cut in the office, any open wound can, and often does, provide the route of entry into the body for infectious agents. Needle-sticks are believed to be a prime mode of

transmission for hepatitis-B, a serious, chronic disease, prevalent among hospital workers.

All needle-stick wounds must be attended to and rigorous employee education and training should emphasize the need to report and treat each wound, no matter how slight. All wounds should be cleaned immediately and the worker's immune status for hepatitis-B and tetanus determined, as recommended by Miskovitz,[3] in order to ascertain whether further immunization is required. The health of the patient in contact with the needle or other sharp item must be determined, particularly hepatitis antigen status and health history for deciding on the course of worker prophylaxis. Unfortunately, if the puncture occurs in the laundry, as it frequently does, identification of the patient source may not be possible, making the task of risk analysis considerably more difficult.

*BACK INJURIES* in hospital work, as in other industries, are the leading cause of lost work time. Unaided patient lifting is thought to be the primary cause of such injury. Aids to patient lifting, such as mechanical hoists and team lifting by more than one worker can prevent the musculoskeletal strain which leads to injury. Frequent and repeated employee training, which includes proper lifting techniques and exercises to keep the muscles in shape, are also essential aspects of back injury prevention. Unfortunately, the realities of short staffing of health care institutions and almost nonexistent inservice training programs, as discussed below, help to perpetuate this major safety and health problem.

*VIOLENCE* against health care facility staff, both by institutionalized patients and by intruders is a growing problem as well. Since health care work has 24-hour requirements, there will always be staff traveling to and from work at relatively high crime hours. In addition, many health care facilities are in inner city, high crime rate areas, areas which may have undergone considerable socioeconomic decline around the institution. Workers in these areas are inherently at greater risk for attack. Hospital workers are made more vulnerable by the requirement that the hospital remain open and accessible for emergency care, and that there is heavy traffic during the day, making perfect security extremely difficult to achieve. The construction of many health care facilities, which includes long, dark tunnels connecting buildings and open stairwells for rapid interfloor passage, adds to the security risks.

There are no firm statistics on the extent of the personal security problem but health administrators and nursing directors are well aware of the difficulties of attracting and retaining staff in many institutions, even the most prestigious, as a result of fears for personal safety.

*CHEMICAL SAFETY HAZARDS* in many areas of the health care setting are similar to the hazards in the industrial laboratory. Clinical laboratories utilize a very large number of toxic chemicals for routine analysis. Some, such as formaldehyde, are potent alkylating agents, suspected human carcinogens and are present in significant quantities in the air. Many medical centers also house basic research facilities with all the attendant potential safety hazards of any laboratory. No accurate data on chemical usage in the typical hospital are available; only rough surveys and anecdotal material are available. One tragic anecdote involves the use and improper disposal of picric acid, a highly explosive chemical, used in burn management as a disinfectant and for selected measurements. When disposed down the drain, it can and did lead to explosions, causing the St. Paul Fire and Marine Insurance Company to issue a special warning. The Company's inspections revealed many institutions where picric acid lies on shelves forgotten, and where personnel were totally untrained as to its potential explosivity.

In addition to chemical reagents, gas cylinders are used in many hospital locations to supply oxygen, nitrous oxide, ethylene oxide and other gases. Special precautions for securing these cylinders and training in appropriate use are needed.

In all areas where chemicals are routinely used, standard laboratory safety equipment must be available. Eye-wash stations, chemical showers, exhaust fume hoods, safety warning signs, non-slip floors and so on are examples of appropriate equipment.

*ELECTRICAL HAZARDS*, sometimes from unexpected sources, are commonly encountered in health care. Meth[4] reviews some of them. One unusual source of electrical hazard, perhaps more for the patient than the staff member, is "leakage current," or low levels of electric current present on the surface of all electrical equipment. A nurse touching a properly functioning reading lamp and laying her hand on the patient at the same time can cause leakage current to flow through her into the patient. The nurse may not sense anything while the microshock may present a serious hazard to the debilitated patient.

Of more significance to occupational health are hazards such as "ground faults," which deliver significant electrical shock to the workers. Ground fault accidents occur where equipment is inadequately grounded (two-prong plugs rather than three). Although it goes without saying that all equipment used in the hospital must adhere to strict electrical code, equipment adequate as originally purchased may no longer be safe if not maintained properly. Frayed wires are one serious problem which nurses can and should inspect frequently. Electrical appliances, like hair dryers and radios, brought in by patients, usually are not adequately equipped for safety.

Electrical sockets should hold a plug firmly. A plug should require some force when being inserted. A socket which accepts a plug without the need for some exertion may be faulty or the plug may be inadequate. "Cheaters" or plugs which convert a three-holed plug into a two-holed one, should never be used.

Water and electrical equipment do not mix. Unfortunately, in areas like laundries, the combination is almost inevitable. In no instance should a two-holed plug be used where any contact with water can occur. The

**TABLE***

## A RECOMMENDED INSPECTION FOR HOSPITALS

### FIRE PROTECTION

1. Are all fire alarm devices periodically tested and in operating condition? .....
2. Have all personnel been trained in the use of hand fire extinguishers? .....
3. Have all fire extinguishers been checked for full charge within the last year and are they of proper type for use in the area where located? .....
4. Are sprinkler heads free of paint and corrosion? .....
5. Are all sprinkler heads unobstructed? .....
6. Are all sprinkler valves open? .....
7. Is standpipe hose dry and in good condition? .....
8. Are self-closing fire doors in operable condition? .....and free from obstruction? .....
9. Are all doors in smoke control partitions in operable condition? .....and free from obstruction? .
10. Are weekly tests made on fire pumps? .....

### FIRE DRILLS

1. Has a fire drill been held or scheduled for this month? .....
2. Are all personnel trained in fire emergency procedure? .....
3. Has a plan for building evacuation been approved by the Bureau of Fire Prevention? .....

### EXITS

1. Are accesses to exits, and discharges from exits properly maintained and free of obstruction? . .
2. Are all doors in means of egress, except doors in patient rooms, kept closed? .....
3. Are doors in required means of egress easily opened from the side from which egress is to be made?
4. Are exit signs in place and properly illuminated? .....

### ELECTRICAL POWER SYSTEMS

1. Are emergency generator sets and load transfer switches operated each week for at least 30 minutes? .....Are storage batteries inspected every 7 days? .....
2. Have circuits and feeders been checked recently to confirm that they are protected with the proper size fuses or circuit breakers? .....

### ANESTHETIZING LOCATIONS

1. Is at least 50% relative humidity maintained whenever the room is in use? .....
2. Do all personnel and visitors wear conductive footwear? .....Is a daily test made to confirm that the wearer is in electrical contact with the conductive floor? .....
3. Are approved, conductive garments and accessories being used? .....
4. Are monthly tests made of conductive floors, furniture, and all accessories? .....
5. Are approved detergents, cleaners, waxes, or sealers used on conductive flooring? .....
6. Is all apparatus labeled indicating it is approved for use in this location? .....
7. Is an equipotential grounding system installed and properly maintained? .....
8. Are weekly tests made to establish proper functioning of the Line Isolation Monitor? .....
9. Is the continuity between the patient ground point, the operating table, and the anesthesia machine tested prior to the application of electric equipment to the patient? .....
10. Is smoking prohibited in anesthetizing locations? .....and in the corridors adjacent to these locations? .....

### MEDICAL GAS STORAGE

1. Are cylinders of flammable medical gases and oxygen or nitrous oxide stored in separate rooms? .
2. Are medical gas cylinders securely fastened to prevent falling and possible valve damage? .....

### FLAMMABLE LIQUIDS STORAGE, DISPENSING, AND USE

1. Is the ventilation system in the storage room operating correctly? .....
2. Are approved containers, pumps and self-closing faucets used? .....
3. Are metal containers properly grounded while filling to prevent accumulation of static electricity? .

*(continued)*

**TABLE** *(continued)*

**HOUSEKEEPING**

1. Is all refuse removed from the premises daily? .....
2. Are enclosed stairways and hallways, and shafts of elevators and dumbwaiters free of stored materials? .....
3. Check any of the following locations or rooms where there are any accumulations of waste paper, rubbish, old furniture, etc., and explain under remarks. Basement.....boiler or furnace.....laundry .....kitchen.....therapy.....pharmacy.....laboratory.....attic.....other.....

**MAINTENANCE SHOPS**

1. Are carpentry, paint, and other maintenance shops clean and orderly? .....
2. Are flammable and combustible supplies kept in a safe location? .....

**DECORATIONS**

1. Are combustible decorations, draperies, fabrics, etc., flame proofed and retreated on a scheduled basis? .....

**KITCHENS**

1. Is the schedule for cleaning grease filters in appliance ventilating systems consistently followed? .
2. Are fixed fire extinguishing systems properly maintained? .....
3. Is the hood and ductwork beyond the grease filters free of grease? .....
4. Are portable fire extinguishers available?.....and charged? .....

**LAUNDRY**

1. Are all automatic controls on dryers, mangles, irons and other heated devices operating properly?

**X-RAY**

1. If used, is all highly flammable cellulose nitrate x-ray film stored properly and accounted for?.....

**PHARMACY**

1. Are all personnel aware of those materials and procedures that are known to be potentially hazardous? .....

**RADIOACTIVE MATERIALS**

1. Is the fire department kept informed of the location, type and quantity of radioactive materials on hand? .....

**Based on Recommendations by American Insurance Association, Engineering and Safety Service, 85 John Street, New York, N.Y. 10038.*

International Labour Office cites electrical hazards, due to poorly designed and maintained equipment, as a prime cause of injuries in laundry work. (Burns, scalds, back injuries, puncture wounds and infections are other frequently encountered hazards).

An example of a ground fault accident is a nurse who touches a pipe or metal sink at the same time that she is in contact with a piece of faulty equipment housed in a metal case. The current will pass from the equipment, through her and to the pipes, which are grounded. The result of this accident can range from mere discomfort, to serious injury or even to death.

*FIRE* is a perennial fear of the hospital administrator and worker. There are many sources of fire hazard in the hospital such as flammable gases, like oxygen, which are routinely used with electrical equipment. A stray spark from such equipment can lead to fire. Motors must be specifically rated for use in chemical environments.

Many of the chemicals in the laboratory are flammable and little, if any, fire safety training is routinely available in most institutions. The patients themselves may cause fires by smoking in bed or using unapproved electrical equipment without being noticed by hospital staff. Electrical wiring may become frayed or the wiring within the conduits that run inside the walls can be the source of a fire.

The inadequacy of many institutions to deal with a real fire emergency is very serious. Hargest,[5] for example, raises the issue of evacuating bed-ridden patients. If elevators are not to be used and stairwells don't accommodate stretchers easily, how then is evacuation to be accomplished? He suggests patient litter hoists on the exterior of buildings as

one solution. Perhaps even more important is the absence or inadequacy of routine fire safety training for people who work in the large medical centers and nursing homes.

## DISCUSSION

The lack of accurate data on the incidence of occupational injury in health care and the relative dearth of inservice training and educational materials are obvious areas in need of immediate attention. The National Institute for Occupational Safety and Health survey on hospital occupational health services, released in 1976, confirmed these statements, with more than one third of all hospitals reporting no formal occupational health program for their employees.

One clue to the greater risks of hospital workers can be drawn from a study of the utilization of hospitals by hospital employees and their families, who were found to have a group rate of 98.6/10,000 admissions for injuries and poisonings compared to 76.9/10,000 among non-hospital worker patients. Although the greater usage of hospitalization may relate to accessibility and health awareness, as posited by the authors,[6] an alternate hypothesis, at least for this cause of illness, is that hospital workers may indeed be suffering from more injuries as a result of their work.

Inadequate maintenance practices in health care settings is undoubtedly a root cause of safety hazards. In one survey[7] we found overflowing garbage cans in clinical laboratories to be a routine occurrence, attributable in part, to too infrequent cleaning. We found mouth pipetting to be a frequent practice (82% of all respondents). Twenty percent of the 696 lab workers surveyed, reported as routine practice in their laboratories the disposal of used hypodermic needles with the rest of the garbage.

Inservice training and education are also essential aspects of maintaining hospital safety as are frequent inspections of the facilities. The Table, prepared by the American Insurance Association, details the basic factors to be observed in an inspection.

Primary prevention through training, inspection, improved facility and more adequate staffing can help stem the growing tide of safety hazards in the hospital setting.

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# Designing the Workplace for Health and Safety: Biomechanical Considerations

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## FITTING MACHINES TO BODIES: THE SCIENCE OF BIOMECHANICS

Equipment, tools and furniture are an important part of the workplace environment. Just as toxic chemicals can cause discomfort and disease, poorly designed, uncomfortable or unpleasant equipment and furnishings can be a source of health hazards on the job. The chairs we sit in, the tables we work at, the tools we manipulate, and the machines we operate all contribute significantly to our working conditions and hence to our emotional and physical well-being. However, all too frequently these components of the working environment are not analyzed for their health effects. Examples of some of the most important features of workplace design and information to help evaluate and correct hazardous conditions will be discussed here. Chairs and stools, work surfaces and desks, hand tools, lifting and video display terminal work stations will be used for illustration of design principles.

Workplace equipment, tools and furniture all cause the human body to assume particular postures. A good working posture, which places a minimum stress load on the skeleton and muscles, is a fundamental consideration in the design of workplace equipment, tools and furniture. Poor working postures on the job, such as assembling machine parts at a table that is too high, can lead to spinal disorders and muscle fatigue. A posturally stressed worker may develop chronic backache. Other muscles, joints, tendons and nerves in the arms, pelvis, legs, neck and trunk can also be fatigued or injured by incorrectly designed work environments.

The musculoskeletal system of the human body is a collection of bony levers (the limbs) connected by joints. Work is done by the contraction of muscles as weights are lifted, or movements made, or particular positions held against the force of gravity. Such work is frequently referred to as muscle loading. Each bony lever has a particular range of movement that is optimal, given its size, the muscles that activate its movement, and the particular weight being moved or held.[1] For example, to stand upright requires work since the human body is not "balanced" in the standing position. We would fall flat from the upright position if our calves were not constantly working to "pull us back."[2] Thus, standing in a static position is fatiguing over the course of an eight-hour day since the muscles are working in the standing position.

Biomechanics is the area of science devoted to study how the bones and muscles conform to physical and biological laws. Biomechanical studies of work environment analyze the energy expended during different tasks and the interaction between the body, machines and furniture, and seek an understanding of how the body reacts to particular work movements and positions. A goal of good biomechanical design applied to the workplace is aptly summarized by Dr. Erwin Tichauer, a leader in the field: "No sore backs, shoulders, wrists or behinds."[2]

The design of the job itself is an important component of furniture and equipment design. Even an ideal posture can cause muscle and skeletal "loading" if it has to be maintained for too long with little or no opportunity for body movement. The human body is designed to move. Static positions are contrary to biological requirements. In order to accommodate the natural need for body movement, jobs must be designed to provide the opportunity to move. A machine which requires a static position, such as working at a visual display terminal (VDT), which requires the operator always to look at the screen, will cause the neck and eye muscles to become unduly fatigued. Job rotations and breaks will help to solve this problem as will an adjustable VDT screen which permits the operator to change positions. The mechanical energy expended in simply changing the posture will partially relieve static muscular loading. An ideal arrangement for a work environment will include frequent changes in work positions. For example, sales clerks can be provided with tall stools to alternate sitting and standing to reduce muscular fatigue.

## FINDING A CHAIR THAT FITS

Chairs are frequently an example of poorly designed, uncomfortable or unpleasant workplace equipment.* For example, if the chair seat is too wide, it will press the back of the thighs, impeding circulation, and aggravating, or perhaps even causing, circulatory problems such as varicose veins or hemorrhoids.

There are four key factors in a well-designed chair: the seat, its height, the backrest, and the construction materials. The key word in chair design is adaptability. Chairs must be adjustable to meet worker dimensions and biomechanical needs. Currently, too many chairs demand that workers adapt to them and not vice versa.

It is not difficult to tell whether the workers and the chairs are suited to each other. When a worker sits on a chair, the hips and knees should be at right angles and feet flat on the floor. The highest point of the chair should be approximately two inches less than the distance between the crease behind the knee and the floor when standing straight. This knee crease-floor distance is known as the "popliteal height."

Seat height is particularly critical if a job entails moving the feet or arms to operate a foot pedal or other equipment. An incorrect height will strain muscles in the back and legs and may even lead to muscle-joint disease.* An important feature of chair design is support for the lower back. The best backrests are small and kidney shaped. The backrest should fit snugly in the small of the back in order to support the spine and lower back. The backrest should be able to tilt back and forth in order to accommodate routine body movement. A backrest that meets the back too high or that doesn't move may cause bruises if frequent body rotations are required by the job. In a job which involves frequent sideway motions to reach for materials or equipment, adjustability of the backrest can make a real difference in the way the entire body feels at the end of the workday.

A job that requires frequent motion will also be eased by a chair that moves along the floor easily. On the other hand, slipping and sliding can also be a problem. In general, it is better not to have coasters on a chair unless you are constantly moving from task to task since coasters can cause strain on calf muscles as the worker continually tries to "anchor" herself into place. They can also lead to accidents. Here, too, adjustability is the answer and it should be decided just how much sliding ability is needed to be safe, comfortable and not strained. Some chairs are available with coasters that can be "locked" to prevent sliding, when not needed.

The stability of the chair, its support and the seat height are complemented by the shape of the seat itself. The seat should be slanted slightly backward, just sufficiently to allow the worker to lean back and use the backrest. It should not be so slanted, however, that it causes one to fall back into the seat or forces straining to reach things and makes sitting up an unconscious effort. The edge of the seat should be scrolled so that it doesn't dig into the back of the legs and the entire seat should swivel, particularly, as we have discussed, if the work requires turning of the torso. A swiveling seat allows continual use of the backrest while turning.

Seat size is critical. A chair seat that is too long can place unnecessary pressure on the lower back and thighs, since the seat will force leaning forward in order to work. The well-designed seat will end five inches behind the crease in the knee while sitting straight and using the backrest.

The material used for the seat should be porous and allow normal body heat to dissipate. Wool and rayon textured fabrics are best. The texture prevents sliding forward. Vinyl and other plastic seat covers are not ideal since they do not allow body heat to escape. The heat and perspiration problem will be exacerbated if layers of clothing made from synthetic materials are worn, as most women do. For example, the woman with nylon or acetate underpants, nylon pantyhose, an acetate slip and polyester skirt sitting on a vinyl chair seat is effectively in contact with five layers of plastic which will trap the body heat and cause excessive perspiration. In addition to discomfort, problems like rashes and irritation

*Many research studies have documented problems with chair design. See, for example: Ferguson D, Duncan, J: Keyboard design and operating posture.* Ergonomics *17:731-744, 1974; and Grandjean E:* Fitting the Task to the Man: An Ergonomic Approach. *London, Taylor and French, 1967.*

*It is interesting to note that sedentary workers frequently experience low back pain. See, for example, Milanowska K: Biomechanical aspects of the rehabilitation of patients with low back pain connected with discopathy, in Asmussen E, Jorgenson K:* Biomechanics VI-B *(International Congress of Biomechanics), Baltimore, Maryland, University Press, 1978.*

can occur. There are many examples in the medical literature of bladder infections and vaginitis which have been attributed to this cause.

An irony of poor chair design is that, in addition to contributing to discomfort and possibly ill health, poorly designed chairs handicap the ability to work efficiently. Research has shown that at least 40 minutes of productive time are lost each day because of poor workplace design, some attributable to the chair. Another study has demonstrated that workers who improvise their seating arrangements with pillows, cushions and backrests devices brought from home, spend several hours a week adjusting these makeshift devices for comfort.[1] A cost-benefit analysis that took such "productivity" losses into account would probably justify an immediate outlay for new chairs. It is also ironic that the most expensive chairs (though not necessarily the best designed) are reserved for the executives who spend comparatively the least amount of time at their workstations in the office.[3] The factors for good chair design which we have discussed here are certainly not complicated, and it is actually surprising that so few chairs meet these simple specifications.

## WORK SURFACES

Just as chairs must fit the person who sits on them and correspond to the needs of the job, so too a work surface must accommodate both user and tasks. Proper height of the working surface is important to physical comfort. The height is called the working level and is defined as the distance between the back of the thighs while sitting and the palms of the hands while actually engaged in work.[4] The working level can be measured by having an individual sit upright with forearms and palms held horizontally. An appropriately designed work surface will allow your hands and forearms to be at right angles to your body while using the desk surface. The right angle-horizontal position is the one which places the least strain on the muscles and hence is the least fatiguing position to assume.

Most work surface heights are not adjustable but rather are designed to fit the average person, usually male. This generally means that the chair height will have to be adjusted to obtain the necessary horizontal forearm position. Adjusting the seat height may not work, however, because if you make the chair seat height too high, the feet may not be able to rest on the floor while maintaining the thighs in a horizontal position. This will be exchanging one limb problem for another. If the seat must be raised to reach the desk, a footrest may be necessary. For comfort and safety, the footrest should be adjustable for height and angle of inclination and should never be left in the aisle where someone may accidentally trip over it and be injured.

Another spatial requirement for working surfaces is freedom of movement. Adequate room is needed between the thighs and knees and the surface. There also must be adequate clearance behind the chair for getting into and out of the working position.

## PREVENTING HAND AND WRIST DISORDERS[5]

Typists, cashiers, mail handlers, packers, light assembly workers — people who use their hands, wrists and fingers in quick, flexing, repetitive motions — often suffer from such painful ailments as tenosynovitis.[6] Symptoms include pain, swelling and difficulty in moving the wrist or forearm, caused by inflammation of tendons. Quite often, other symptoms accompany tenosynovitis: tense and painful neck muscles or inflammation of the shoulder or the elbow. The latter is popularly known as "tennis elbow."

Tenosynovitis is caused by too much speed in work, and workplaces, jobs and tools that are not designed to fit comfortably with the structure of the human hand.[7] Carpal tunnel syndrome is a disorder caused by similar workplace conditions. This syndrome occurs due to the pressure on the carpal tunnel, a channel in the wrist through which important nerves and blood vessels flow. Such pressures can injure the median nerve inside the wrist causing feelings in the hands and fingers of coldness, numbness and tingling. For example, one study of sewers and stitchers in an upholstery plant found many workers who bent their wrists and pinched the fabric as they guided it for stitching, suffered from carpal tunnel syndrome.[8]

Complete rest away from the job may cure tenosynovitis and related disorders, but as soon as the worker goes back it may flare up again. The only reasonable way to deal with it is to prevent it — which means redesigning jobs, workplaces and tools. This is particularly important for women because most tools and equipment are designed for a man's hand size and grip. A number of preventable factors can contribute to hand and wrist ailments. A careful survey of the workplace should be undertaken to see if any of the following biomechanical problems exist:

- Work gloves should not be too large or thick, especially between the fingers. If they are, it is difficult to get a firm hold on a tool or other work object; the worker is more apt to grip overtightly, causing strain and fatigue.
- Hand tools should not put undue pressure on any one spot on the hand. Pressure should be distributed over a large enough area so that damage is avoided to the nerves in the hand.
- The toughest part of the hand is the vertex of the angle between thumb and fingers. Hand tools should thus be designed so that the most pressure falls here, not between the individual fingers where there are many vulnerable nerves and blood vessels.
- So-called "form-fitting" handles on tools should be avoided, since they are usually designed to fit some mythically "average" hand, one like the designer's. When finger grooving is used to facilitate a firm grip on a tool, it should be shaped in a way that will not put undue stress between the fingers of a hand that may be either too small or too

large to hold it well.

- Particularly important in preventing tenosynovitis is keeping the hand aligned with the wrist. Grasping a small object while working with a bent wrist is especially stressful to the wrist. Thus, tools should be redesigned so that it is the tool that bends, not the wrist.

  For example, the turkey-boning knife in a poultry plant was redesigned so that the handle was bent to almost a right angle in relationship to the knife blade.[9] This design reduced wrist deviations while thigh boning and consequently, strain on the wrist.

  The only exception to the "straight wrist rule" is when grasping is accompanied by fine manipulation of the fingers, as in fine wiring or jewelry making. Then the movements are more comfortable when the wrist is bent.

Since overstress is a main cause of tenosynovitis and related ailments, reducing the speed of the work may be necessary. This is particularly important in cases where it is difficult to redesign tools, equipment or workplace layout. Another good preventive measure is alternating jobs so that the same worker does not repeat the same stressful motions all day long.

Tasks should also be avoided that require prolonged bending of the wrist while moving the forearm, as in hammering nails into an overhead object.

Particularly bad for fingers are tasks that require too wide a grip on a handle while pushing down a finger. If repeated too long, this can result in inflammation of the finger joints, or "trigger finger."

The only finger that tolerates repeated flexing is the thumb. The muscles from the other fingers reach all the way down the forearm to the elbow region, while thumb muscles are short and strong, leading only to the palm of the hand. Thus, whenever possible, push buttons operated by the thumb should be substituted for triggers activated by other fingers.

All of these considerations can reduce hand and wrist injuries and make the working environment more comfortable for the worker.

## LIFTING

Back strain is caused by twisting, stretching or pulling the muscles and ligaments of the back, especially when lifting, carrying loads or stretching. It is especially important to prevent back injuries because once a back is injured, the muscles and ligaments become scarred and weakened, and susceptibility to repeated back strain is increased. Most heavy lifting on jobs can be eliminated by the use of mechanical lifting devices such as fork-lift trucks, hand trucks, conveyors, lifting tackle and cranes. Nurses in hospitals, for example, who suffer many back injuries while moving patients, can prevent this injury by using a Heuyer lift to move and transfer patients. This device, commonly used in Great Britain, is rarely available in U.S. hospitals, and avoidable back strain is the result.

Conditioning programs can also be useful to strengthen muscles needed for particular types of work. Women, for example, who have become coal miners, firefighters and telephone-line repairers have found conditioning programs useful to prepare them for their jobs. Both men and women are able to lift more weight between the ages of approximately 18 and 35. As people get older the ligaments encasing the spinal discs stiffen and tear more easily from rotating or bending the spine. A "ruptured disc" may result, causing pain by pressing the nerves that enter and leave the spinal cord.

## VIDEO DISPLAY TERMINALS

Video display terminals, or VDTs, are the connection between a worker and a computer. VDTs look like a television screen hooked up to a typewriter keyboard.

Many VDTs are poorly designed. Hence, with more and more workers spending longer periods of time using VDTs, more and more worker complaints about discomfort and health problems are being aired. Visual strain, visual fatigue, sore eyes, itching, tingling, tearing and bloodshot eyes are specific problems often mentioned.[10] Back and neck aches, sore arms, and other muscle strains due to uncomfortable work positions are also prevalent.[10] Other problems areas are outside the scope of this paper.

VDT work is visually demanding and research studies have shown a decrease in visual acuity (ability to discriminate fine details) and accommodation (ability to focus on objects at different distances from the eye) after working on the VDT for several hours.[11] A number of workplace design factors can help reduce eyestrain. Some workers will need special VDT glasses ground to the focal length of approximately 28 inches (the typical distance between the VDT and the viewer) compared to 18 inches for reading glasses. Preventing screen glare and making sure that machines have adjustable brightness and contrast controls can also reduce visual fatigue.

The physical structure of the VDT is also important. The VDT screen should be adjustable, allowing the operator to be able to both tilt and rotate it. The keyboard should be detachable and as thin as possible. This makes it possible to move the keyboard to prevent static postures. Thin keyboards insure better placement of wrists and hands to prevent strain.

As with other work equipment the most important factor for VDTs is adjustability. We must always keep in mind that we are trying to fit machines to human bodies and not the other way around.

## BIOMECHANICAL MONITORING

This paper focused on a few of the most common biomechanical hazards. By applying the general principles discussed, workplaces can be surveyed for biomechanical hazards. Some questions for biomechanical monitoring include:

- Are there particular joint, muscle, nerve or tendon injuries reported frequently?
- Are complaints concentrated among workers performing a

particular operation, or using particular pieces of equipment or tools?

- Can the equipment, tool or process be modified or redesigned to reduce biomechanical strains?

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# Safety Hazards in the Office: Appearances Can Be Hazardous

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The subject of safety hazards on the job typically brings to mind images of failing scaffolds, unshielded machine blades, chemical spills and the like. For the majority of workers in the U.S. today, hazards of this nature are not normally present. However, recent changes in the nature and organization of work processes have introduced many new and often less apparent hazards into the workplace.

Today, growing numbers of people work in offices. Office employment in the state of California, for example, rose by 167% between 1960 and 1978, compared with a 71% increase in total employment.[1] Currently, 42% of the U.S. labor force — roughly 45 million people — are employed in office buildings.[2] Offices are generally viewed as relatively safe places to work. Yet, when accident statistics are examined, it becomes evident that substantial numbers of office injuries do occur. Further, when we look at what types of accidents occur most frequently, patterns emerge which suggest that offices may indeed harbor "hidden" danger zones.

## OFFICE INJURIES: A REVIEW OF THE FACTS

According to the Occupational Safety and Health Administration (OSHA), an estimated 40,000 disabling injuries and 200 safety related deaths occur in offices each year.[3] These figures do not include unreported and nondisabling injuries, however, the addition of which would substantially elevate these statistics. Another measure of office accidents comes from the 1975-1976 Health Interview Survey. In this survey, detailed interviews were conducted on a nationally representative sample of approximately 80,000 households (229,000 individuals). Although the survey provided no information on the type and severity of accidents, some informative comparisons of accident rates between people in different occupations can be made. These findings are summarized in Table 1.

The figures show, as might be expected, that blue-collar workers experienced a work-injury rate over four times as great as did white-collar workers (21.0 compared with 5.1 injuries per 100 persons annually). But when the total number of injuries is compared, the incidence for blue-collar workers is only 2.6 times as great (5.8 million compared with 2.2 million). This is owing to the fact that there are over 50% more people employed in white-collar than in blue-collar occupations.

Among females, those in white-collar occupations had a substantially lower work-injury rate than their blue-collar counterparts (4.7 compared with 10.4 injuries per 100 persons annually). But interestingly, when the total number of accidents is compared, there were almost twice as many injuries among women in the white-collar sector.[4] At present, nearly two thirds of the female labor force are employed in white-collar occupations — the majority as clerical workers. It is no surprise then, to find the highest number of work-related injuries among this group. Certainly, the rate and severity of office accidents is much lower than in heavy industry, but with the increasing numbers of people employed in offices the problem is growing.

Because it has been so widely assumed that "offices are safe," there have been few attempts made at evaluating the real hazards which do exist. The limited work that has been

**TABLE 1**

WORK INJURIES BY SEX AND OCCUPATION, UNITED STATES 1975-1976

| OCCUPATION | MALE | | | FEMALE | | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|
| | Number Employed (In Thousands) | Injury Rate Per 100 Persons Per Year | Number Injured (In Thousands) | Number Employed (In Thousands) | Injury Rate Per 100 Persons Per Year | Number Injured (In Thousands) | Number Employed (In Thousands) | Injury Rate Per 100 Persons Per Year | Number Injured (In Thousands) |
| Currently Employed | 51,119 | 14.7 | 7,514 | 34,049 | 6.0 | 2,043 | 85,168 | 11.2 | 9,539 |
| White Collar | 21,475 | 5.4 | 1,160 | 21,360 | 4.7 | 1,004 | 42,835 | 5.1 | 2,186 |
| Professional & Technical | 7,695 | 6.2 | 477 | 5,481 | 7.3 | 400 | 13,176 | 6.6 | 877 |
| Managers & Administrators | 7,405 | 3.8 | 281 | 2,176 | 6.6 | 144 | 9,581 | 4.4 | 425 |
| Sales | 3,079 | 7.0 | 216 | 2,312 | 3.9 | 90 | 5,391 | 5.7 | 306 |
| Clerical | 3,297 | 5.8 | 191 | 11,390 | 3.2 | 365 | 14,687 | 3.8 | 556 |
| Blue Collar | 22,737 | 23.3 | 5,928 | 5,084 | 10.4 | 529 | 27,822 | 21.0 | 5,843 |
| Other (e.g., Service, Farm) | 6,906 | 6.2 | 428 | 7,575 | 6.7 | 510 | 14,481 | 6.5 | 938 |

*SOURCE: Selected Health Characteristics by Occupation. United States 1975-76. Health Interview Survey. Series 10, Number 133.*

done is primarily based on information gathered by state Workers' Compensation Boards and insurance companies. These reports, by definition, only include work accidents for which claims have been filed. However, they do shed some light on potential safety hazards and are useful as a preliminary source of information.

In one major study, accident statistics were compiled over a five-year period (1962-1966) for workers at the Equitable Life Assurance Company. During this period, 1563 work-accidents occurred. The most frequent kinds of accidents were found to be, in order of magnitude: falls and slips (36.4%); struck by or against (16.4%); strain from overexertion (13.8%); caught in or between (8.2%); moving vehicles (.5%); and miscellaneous (24.1%).[5]

Another study was conducted by the California State Department of Industrial Relations, covering 1 million persons during a one-year period (1959). Results were similar to the previous findings: falls and slips (47.4%); strain from exhaustion (18.9%); struck by or against (17.5%); moving vehicle accidents (4.9%); caught in or between (4.2%); and miscellaneous (4.2%). Falls and slips — which constituted the major accident category — were then analyzed to determine the most frequent places of occurrence. It was found that the most common sites were, in order of magnitude: walking surfaces, stairs and steps, chairs, elevation (e.g., standing on furniture), ladders and elevators. (Refer to Table 2 for more detail.)[5]

These statistics were updated in 1978. A comparison of the number, type and percent change from 1959 to 1978 is provided in Table 3. A substantial increase in both the rate and absolute number of injuries was noted during this period, which cannot simply be accounted for by the increase in the number of office workers, alone. (The number of workers increased by 167% while the number of accidents rose by 349%.)

Although knowledge of the frequency and type of accidents explains nothing about their etiology, it

**TABLE 2**

PERCENT DISTRIBUTION OF WORK INJURIES BY ACCIDENT TYPE, OFFICE WORKERS, CALIFORNIA — 1959 AND 1978

| Accident Type | 1959 | 1978 |
|---|---|---|
| Falls & Slips | 47.4 | 14.8 |
| Strains & Overexhaustion | 18.9 | 26.4 |
| Struck By Or Against | 17.5 | 27.7 |
| Moving Vehicle | 4.9 | 5.7 |
| Caught In Or Between | 4.2 | 2.6 |
| Bodily Reaction | n.a. | 8.7 |
| Other, NEC | 7.1 | 10.2 |
| TOTAL | 100% | 100% |

*n.a.* = not available.

*SOURCE: California Department of Industrial Relations. Work Injuries and Illnesses in California, First Six Months, 1978, (FEB. 1981) and "Safety in the Office", WCB Report, Winter, 1981.*

**TABLE 3**

EMPLOYMENT AND DISABLING WORK INJURIES AND ILLNESSES TO OFFICE WORKERS BY NATURE OF INJURY AND ILLNESS, CALIFORNIA — 1959 AND 1978

| Item | 1959 | 1978 | Percent Change 1959-1978 |
|---|---|---|---|
| Employment | 825,000 | 2,200,000 | 167 |
| Injuries, total: | 2,809 | 12,623 | 349 |
| Amputations or enucleations | 6 | 4 | −33 |
| Burns and scalds | 33 | 128 | 288 |
| Contusions, crushing injuries, bruises | 598 | 2,306 | 286 |
| Cuts, lacerations, punctures | 296 | 1,065 | 260 |
| Scratches, abrasions | 119 | 380 | 219 |
| Fractures | 410 | 1,120 | 173 |
| Sprains, strains, dislocations, hernias | 1,250 | 7,312 | 485 |
| Other injuries | 97 | 308 | 218 |

*SOURCE: California Department of Industrial Relations. "Work Injuries and Illnesses in California. First Six Months, 1978."*

**TABLE 4**

A CHECKLIST FOR EVALUATING OFFICE SAFETY

| Hazard | Check |
|---|---|
| SLIPS AND FALLS | ☐ Is the office generally "cluttered" with boxes or other objects? |
| | ☐ If so, where could they be stored so that they would not create obstructions? |
| | ☐ Are there electrical cords or telephone wires extending across walk areas? |
| | ☐ Are the wires taped down? |
| | ☐ Are the floors cleaned regularly? |
| | ☐ Is the floor made of non-slip material? |
| | ☐ Are all areas of the office — including stairways and entrance halls — well lit? |
| | ☐ Are there handrails on all staircases? |
| | ☐ Have there been any recent incidences of workers falling or tripping in the office? |
| | ☐ If so, in which areas? |
| ELECTRICAL HAZARDS | ☐ Are there several machines plugged into one outlet? |
| | ☐ Are any bare wires exposed? |
| | ☐ Are electrical wires properly grounded? |
| OFFICE MACHINERY | ☐ Have users been given adequate instruction on the everyday use and maintenance of equipment — such as photocopiers and printers? |
| | ☐ Do all machines clearly indicate when they're turned on? |
| | ☐ Are there machine guards on any potentially dangerous parts of the equipment — such as locks on paper cutters? |
| | ☐ Are there any machines in the office which might be considered dangerous? |
| STRAINS AND SPRAINS | ☐ Are dollys and hand trucks available to help in moving and lifting? |
| | ☐ Is training provided in proper lifting techniques? |
| | ☐ Have there been any recent complaints of muscle or back strain? |
| OFFICE DESIGN | ☐ Is the office "overcrowded"? |
| | ☐ If there are any temporary partitions, are they well secured to the floor? |
| | ☐ Are there any sharp or protruding edges from desks or other furniture? |
| | ☐ Is there adequate room for storing supplies and files in the office? |
| FIRE SAFETY | ☐ Are there flammable materials used in the office, such as cleaning fluids, or photocopier inks? |
| | ☐ Are they safely stored and disposed of? |
| | ☐ Is there an evacuation plan in case of fire? |
| | ☐ Are there regular fire drills in the office? |
| | ☐ Are fire exitss well marked and free of obstruction? |
| | ☐ Are there fire alarms, sprinkler systems and fire extinguishers in the office? |
| | ☐ Are they regularly checked to ensure operability? |

does provide some initial clues about where to look for causes.

## EVALUATING ACCIDENT RISK FACTORS IN THE OFFICE

Often the connection between accidents and their antecedent causes is just a matter of common sense. For example, the high occurrence of trips and falls can be traced to such common hazards as: phone wires or electrical cords strewn across floors; boxes, stacks of paper or other objects piled in walkways; or highly waxed or wet floors. Climbing on unsturdy chairs or ladders when reaching for high places is obviously another potential source of falls. Strains may be the result of having to work in uncomfortable positions — such as at desks that are too short or

too high — improperly designed chairs, or excessive lifting. Loose clothing or dangling jewelry can be caught in office machines. Sharp or protruding desk edges can lead to bruises. (A more complete safety evaluation checklist is provided in Table 4.)

When examined more carefully, these apparent hazards may actually be signs of underlying problems in office or job design. A thorough evaluation of the office must not only take into account these immediate causes, but must also examine predisposing factors in office design, task organization, and administrative practices.

Most of the research and evaluation of factors which may contribute to the cause of work accidents has focused on industrial settings. Initially, studies were undertaken in order to find ways of increasing productivity and reducing accident costs.[6] Some of the principles and approaches used in industrial accident evaluation are applicable to offices as well.

At the Women's Occupational Health Resource Center, the evaluation of safety hazards is approached from an ergonomic or human factors perspective. This approach emphasizes that accidents are often the results of "maladjustment" between people and their work environment (e.g., the tools and equipment they use). Accordingly, accident reduction and prevention becomes more than simply a matter of changing individual behavior and attitudes, but also involves modification of equipment and job design. Human factors research has identified a number of characteristics in the work environment and task organization which may contribute to accident causation. These include: noise, temperature, lighting, time of day, rate of production, equipment and workspace design.[6] Many of these risk factors operate in industrial and office settings alike. The most important factors, with respect to offices, are highlighted here.

*Office Design:* The design of many contemporary offices may indeed contribute to increased accident risks. In the past two decades, a new concept in design — the open-plan office — swept across businesses throughout North America. One recent study found that half of all white-collar workers in the U.S. currently work in open offices, and the numbers appear to be increasing.[7] The open-plan arrangement is characterized by large open areas, divided into individual workstations by movable partitions, file cabinets, bookshelves and other furniture. One of the motivations behind the open-plan office is that it allows for increased flexibility and easy rearrangement as staffing changes are made. Currently, with such a high premium on new office space, the advantages of this plan are obvious.

But this modern innovation is not always an advancement from the point of view of user safety. Many architects and design engineers of open offices have been trained to focus on machine and workstation design. Unfortunately, user safety and comfort is often secondary to style and appearance, except in the most expensive lines of furniture and equipment. An example is the sleek, colorful workstations and desks which can't be adjusted to fit the office workers who must use them. (For a more in-depth discussion of ergonomic considerations in furniture design see M.S. Henifin's article elsewhere in this issue.) Muscle strains — particularly neck and back strain — are common complaints among workers who must sit all day long at improperly 'fitting" desks and chairs.

Several other potential safety hazards are present in the open office. Often the movable partitions are inadequately secured, and may be easily knocked over by passers by. When workstations are moved, telephone and electrical outlets may no longer be located within easy access. To solve this problem, extension cords may be strung across floors, possibly causing tripping. In addition, if the wires aren't properly grounded, electrical hazards — such as shock or electrocution — become more likely. Further, the increased "flexibility" afforded by the open office can become a double-edged sword. The potential for additional people to move into a work area, coupled with the high cost of purchasing new office space, can easily lead to overcrowding. Many businesses have expanded into storage areas and basements, rather than move into larger offices. Often, these makeshift workstations are in areas not intended for human occupancy, and do not provide adequate lighting, ventilation and space. Inadequate ventilation may create feelings of drowsiness, which can increase the potential for accidents to occur. Overcrowding can create many obvious safety hazards. When there is not enough room to work and store supplies, access ways may be used for these purposes.

*Office Equipment:* Today's offices are filled with various technological innovations — such as photocopiers, printers, and paper shredders. Some of the safety hazards associated with the electrical wires from these machines have already been mentioned. In addition, overuse of electrical outlets may lead to increased risks of short circuiting. Another problem is that often, new machines are purchased, in an effort to increase efficiency, without taking the time to consider where they should be placed. They are installed wherever existing office space permits, often blocking passageways, and not allowing for adequate operator movement. Breakdowns are common with most of these technological innovations, and the pressure of having to complete projects under deadline encourages workers to try to repair the machine themselves. Numerous hazards may result when people who have not received proper training in equipment repair and maintenance try and undertake these tasks. Many machines do not come equipped with safety switches and protective guards. Forgetting to switch off the machine before attempting repairs may result in getting one's fingers, clothing or jewelry caught inside.

*Fire Safety:* In this era of "windowless" offices and hi-polymer plastics, fire safety is becoming more important than ever. The typical modern office building is now designed without windows that open and close.

Instead, it is common to find large glass panes, which extend from floor to ceiling. In the event of fire, flames will tend to spread much more quickly than with brick buildings. Spread of fire is also potentiated in large open areas — in contrast to small offices with walls. In addition, the increased use of plastics in building materials, furniture and accessories may emit highly toxic fumes when burning. Further, the benign image of the "safe office" has meant that building codes frequently go unenforced — fire extinguishers and sprinkler systems may go unchecked for years, and emergency exits and passageways may be used as storage space when the office becomes too croweded.

*Job Design:* With the introduction of many automated features into the office, it has been argued that office work is becoming more and more like factory work.[8] Many office workers are required to perform repetitive or machine-paced tasks — such as keypunching, photocopying and typing. The monotony of these jobs may cause workers to become drowsy and pay less attention to their surroundings. Indeed, tiredness and monotony have been linked with increased accidents in industrial settings.[9]

Workload pressures and inadequate staffing are also a contributory cause of accidents. In the hurry to meet deadlines, carelessness may result. For example, drawers and cabinets may be left open and boxes may be left in piles, creating obstructions.

Having to lift heavy objects — such as typewriters, boxes and other equipment — may result in back strain. This is one of the most common complaints among office workers. Dollys and hand trucks are not always readily available. Proper lifting techniques may not be taught, and, as a consequence, muscle strains may result.

## CONCLUSION: IMPROVING OFFICE SAFETY

We have seen that offices may be filled with a number of potential safety hazards. These conditions may be responsible for injuries which range from minor bruises to broken bones and even death. On the basis of recent trends, we can expect that increasing proportions of the workforce will be employed in offices in the future. The hazards discussed here are unlikely to disappear spontaneously. For these reasons, there is a growing need to pay closer attention to improving office safety.

From an occupational health perspective, primary prevention is the ultimate goal. That is, with alleviating potential safety hazards, rather than just waiting to treat injured or diseased victims. Although preventing injuries and accidents in the office often requires, what seem to be obvious and straightforward measures, even the "most obvious" precautions aren't followed in the everyday flurry of activity. Part of the reason for this neglect is lack of recognition. At a time when public attention on workplace hazards largely focuses on the subject of chemical carcinogens, nuclear accidents and other such dramatic hazards, office safety, by contrast, seems to be a relatively minor problem. It often takes a major office fire or horror story about asbestos insulation to generate interest in the subject.

Many people who work in offices are either unaware of the potential hazards or, if aware, are unsure of how to go about correcting them. Lack of awareness exists particularly in the areas of fire safety and office machines. Increasing awareness and precautionary measures could be accomplished through a variety of means, such as having representatives from companies where equipment is purchased provide training to all potential users. In addition, safety precautions should be posted near equipment.

Substantial progress in improving office safety will only be made when machinery, workstations and other components of the office are designed in such a way to prevent potential accidents, and when office personnel are provided with adequate workspace and time to make safety a regular part of their work agenda.

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# Personal Protective Equipment: Design and Availability Considerations

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Personal protective equipment (PPE) constitutes a broad category of items which are meant to protect a worker from health and safety hazards at the workplace. These items include hard hats, gloves, respirators, steeltoed boots, safety boots, coveralls, protective suits and eye glasses. The type of PPE that a worker should wear will depend on the occupational hazards present at the workplace.

## GUIDELINES FOR PPE USE

As mandated in the OSH Act, guidelines for PPE use are to be included at the time a standard for a specific hazard is set. The exact legislation reads as follows:

> ...where appropriate, such standard shall also prescribe suitable protective equipment and control of technological procedures to be used in connection with such hazards and shall provide for monitoring or measuring employee exposure at such locations and intervals and in such a manner as may be necessary for the protection of the employees.[1]

Therefore, employers must be aware of those hazards in the workplace which require PPE and institute their use. An employer must inform employees when PPE is required, whether permanently or temporarily, for their job.

In 1971, during the promulgation of the OSH Act, 120 standards set by the American National Standards Institute (ANSI), were adopted by OSHA. The breakdown comprised 20 health standards and 100 safety standards.[2] ANSI standards are no longer adopted forthright by OSHA. The National Institute for Occupational Safety and Health (NIOSH) is appointed the task of testing, approving and certifying personal safety devices. Certified PPE will indicate NIOSH's seal of approval or meet the approval of those agencies developing standards of which OSHA approved.

## WHEN TO USE PPE

Personal protective equipment is usually considered a secondary strategy for protecting workers from occupational hazards at the workplace. OSHA stipulates that PPE be worn only when engineering controls cannot adequately clean up the workplace from exposure to health and safety hazards. An employer whose workplace is not in compliance with OSHA standards must install the best available engineering controls for reducing workplace exposures. Thus, engineering controls are the preferred and mandated method of reducing occupational exposures, implying that the primary responsibility for the protection of the worker rests with the employer. Recently, this policy has been undergoing reevaluation and there is a good possibility that the worker will have to assume a greater responsibility for his or her own protection through the use of PPE.[3]

Many workers, in particular female workers, will have great difficulty in complying given the present design and availability of personal protective equipment. There are, however, recognized instances, where even the best available engineering controls are not sufficient to reduce the exposure level and here PPE should be worn concurrently. This is particularly true during emergency decontamination jobs, where exposure to hazardous substances is very high and extremely concentrated. Protective items, including hard hats, gloves and steel-toed boots are worn to ensure against uncontrollable haz-

ards such as flying metal chips or unanticipated falling objects. Temporary worksites, such as construction sites or tunnels and sewers undergoing repairs, are not conducive to engineering controls and the worker will always be required to wear PPE.

## EXISTING PPE: HOW EFFECTIVE IS IT?

In examining the efficacy of existing PPE in the workplace, three categories of problematic areas are recognized:

1. Inadequacy of PPE;
2. Unavailability of PPE;
3. Improper use of PPE.

Any category on the aforementioned list will directly lead to ineffective PPE.

The inadequacy of PPE is largely an effect of equipment design limitations which include uncomfortable equipment and an inadequate range of body proportions as references (i.e., the male Caucasian worker is the representative reference) from which to size the equipment. Both of these design limitations are highly correlated when considering the female or large male worker for whom the equipment was not designed. Uncomfortable and inadequate equipment can detrimentally affect a worker. Kaplan and Knutson observe that an increased number of accidents result from inadequate and improperly fitted PPE.[4] They cite equipment such as gloves, respirators and goggles as items which workers chronically complain of improper fit. A report of the Subcommittee on Occupational Safety and Health found:

> ...many protective equipment items are not being designed and adequately tested to protect workers especially female workers, even though these bear an American National Standard Institute (ANSI) label. Many items are not inspected to assure full compliance with ANSI standards. Protective equipment items are designed primarily for the average-sized male worker and thus provide little or no protection for many female workers and probably also for larger sized male workers.[5]

The unavailability of varying sizes in PPE has adversely affected workers. The Coal Employment Project surveyed women miners for their utilization practices of PPE in the mining industry.[6] Seventy-five percent of the women miners surveyed wore men's boots. Well over half of these women could not find boots available in women's sizes. Those women miners who did wear women's boots complained of the poor quality and durability of the item. In many cases, both coveralls and gloves were not available in women's sizes.

Lack of availability of women's sizes and extra large men's sizes is clearly problematic. The Women's Occupational Health Resource Center surveyed suppliers and manufacturers of PPE. They found that fewer than half of the companies surveyed provided items in women's sizing.[7] It is stipulated by OSHA that employers must provide a worker with PPE or with order information for obtaining appropriate sizing but there exists a gap between supplying a range of suitable PPE sizes at the workplace and finding the limited number of suppliers and manufacturers that carry women's sizes. Table 1 lists suppliers and/or manufacturers which carry sizes appropriate for women and possibly for some non-Caucasian males.

It is very important to select the appropriate PPE and to use PPE properly. Respirators when not in use are frequently stored, either permanently or temporarily, in dusty environments creating a potential reservoir for exposure to hazardous materials. PPE will become ineffective when regular maintenance is not performed. Finally, care should be taken to select appropriate equipment. For example, wearing a particle collecting respirator will not adequately protect the worker exposed to toxic gases.

## REQUIRED STANDARDS FOR PPE

NIOSH approved respirators will be stamped with an approval number on the front. Different types of respirators are used under specific workplace circumstances. A thorough description of the classes of respirators can be found in the NIOSH publication, *The Industrial Environment: Its Evaluation and Control,*[8] which includes particle or gas and vapor-removing air purifying respirators and atmosphere supplying respirators. Important human factors affecting the efficiency of respirators include: the presence of sideburns, beards, and eyeglass temples, the absence of one or both dentures, and the stiffness or length of hair. These factors can seriously effect the ability of the respirator to form an air-tight seal between the face and the facepiece. The design of respirators was based on a male Caucasian worker. Redesign of respirators based on anthropometric measures are being considered and plans are being made to incorporate them in NIOSH standards.[9]

Safety steel-toed boots are based on two tests: (1) compression and (2) impact. Permeability and penetration tests need to be developed and incorporated as standard tests. Currently, there is no standard for women's safety shoes.

Earplugs are instrumental to protecting a worker's hearing though only when they fit properly. Availability of sizes in earplugs is limited and poses a serious threat to the hearing of those workers unable to be fitted. Universal foam earplugs are currently being tested for their efficiency. One such study indicates that they are effective for attenuating certain frequencies of noise.[10] Adequate consideration of the range of frequencies present at the worksite should be matched with personal hearing protectors and attenuation data. A list of personal hearing protectors and attenuation data can be obtained through NIOSH.[11]

There are many different types of gloves and boots on the market with varying ability to provide a protective seal against certain chemicals. Glove and boot testing apparatuses have been developed in order to test chemical permeation.[12] Systematic testing procedures to provide standards for consumers have not been developed by NIOSH. In the meantime, useful information is available which lists by glovetype the permeation rate

TABLE 1

## MANUFACTURERS/SUPPLIERS CARRYING PPE IN WOMEN'S SIZES

| Manufacturers/ Suppliers | Safety Glasses | Respirators | Gloves | Safety Boots | Hard Hats |
|---|---|---|---|---|---|
| *Safeware<br>3838 Ironwood Place<br>Landover, Maryland 20785<br>(301) 322-1575 | √ | √ | √ | | |
| *National Capital Industries<br>2155 Queens Chapel Rd. NE<br>Washington, D.C. 20018<br>(202) 529-6340 | | √ | √ | special order | √ |
| *Virginia Rubber Corporation<br>P.O. Box 765<br>7502 Fullerton Road<br>Springfield, Virginia 22151<br>(703) 451-4188 | | | √ | √ | |
| *Mine Safety Appliances Co.<br>36 Great Valley Parkway<br>Malvern, Pennsylvania 19355<br>(215) 647-7700 | | | | | √ |
| *Lacrosse Rubber Mill Co.<br>Indian Hill<br>La Crosse, Wisconsin 54601<br>(608) 782-3020 | | | | √ | |
| *American Working Women's Supply Co.<br>P.O. Box 100<br>Deer Park, New York 11729<br>(516) 667-6266 | | | √ | √ | |
| °Eastco Industrial Safety Corporation<br>26-15 123rd Street<br>Flushing, New York 11354<br>(212) 762-2600 | √ | | √ | | |
| °Interex Corporation<br>3 Strathmore Road<br>Natick, Massachusetts 01760<br>(617) 237-6650<br>(800) 225-5910 | | | √ | | |

**Adapted from The Coal Employment Project's survey.*[6]
*°Adapted from the Women's Occupational Health Resource Center PPE factpack.*

of selected chemicals.[13] Similar information for boots is not available.

Government standards for protective clothing do not exist. The following are questions to consider when selecting protective clothing:[14]

- What are the specific job hazards?
- Is a flame-retardant garment necessary?
- Is the nature of the exposure casual or direct?
- Will the garment be worn for a short term or prolonged term?
- Is the temperature of the workplace a consideration?
- Is color important for safety reasons?
- Will the garment require frequent

TABLE 2

## A SAFETY AND HEALTH PERSONAL PROTECTIVE EQUIPMENT CHECKLIST FOR WOMEN

| | |
|---|---|
| RESPIRATORS | ☐ Does your employer regularly monitor the work environment for contaminants?<br>☐ Are you aware of how the hazard can be controlled or prevented?<br>☐ Are you aware of the limitations of respirators?<br>☐ If a respirator is the only solution, is it the proper respirator for the hazards?<br>☐ Was the fit tested *on you*?<br>☐ Were you educated in its use and maintenance? |
| SAFETY SHOES | ☐ Do shoes offer protection against the specific occupational exposure, such as temperature variations, conductivity from static electricity, slippery surfaces, punctures, and chemical exposure? |
| GLOVES | ☐ Are gloves the correct size for you?<br>☐ Are gloves of the appropriate length to prevent exposure?<br>☐ Do gloves offer protection against the specific occupational exposure, such as punctures, chemical exposure, and temperature extremes?<br>☐ Do gloves restrict hand movement?<br>☐ Are they too slippery, too bulky, etc.? |
| SAFETY GOGGLES AND GLASSES | ☐ Do the glasses/goggles offer protection against the specific exposure?<br>☐ Do they distort your vision?<br>☐ Do they limit your peripheral (side) vision?<br>☐ Are there gaps between side shields which might allow particles to enter? |
| HARD HATS | ☐ Does the hat fit properly?<br>☐ Does it offer protection against the specific occupational exposure, such as temperature extremes, falling objects, electrical hazards, etc.?<br>☐ Are liners, chin straps and sweatbands used to keep it in place?<br>☐ Does it cover your hair? |
| EAR MUFFS AND EAR PLUGS | ☐ Are the ear muffs adjustable?<br>☐ Are they comfortable to wear?<br>☐ Do they create pressure to chin, head or behind the ears?<br>☐ Do ear muffs/ear plugs offer reduction of noise, or are noise levels still high even while wearing them?<br>☐ Can you be warned of safety hazards while wearing them (through visual signals such as flashing lights, etc.)? |
| PROTECTIVE CLOTHING | ☐ Is clothing provided in your size?<br>☐ Is it made out of a material that protects you from the specific hazard? |

washing, and if so, is it durable to withstand repeated washing?

## CONCLUSION

When determining the PPE needs of your workplace, it is important to identify those safety and health hazards requiring PPE. It is useful to list each hazard complete with the type of exposure(s) such as inhalation and skin contact. Then, careful delineation of the types of equipment and the types of impenetrable materials necessary for abating certain occupational exposures can be determined.

Next, it is essential to characterize the physical sizes of your working

population to ensure adequate fitting of PPE. Providing appropriate equipment is counterproductive if the equipment does not fit properly.

At the time of purchasing PPE, obtain information from the supplier/manufacturer about the shelf life of the equipment and of any replaceable parts. Also, inquire about the manufacturer's recommendations or guidelines for routine maintenance of the item. For those PPE which NIOSH or OSHA has approved, a certification number must be present.

It is not enough simply to supply PPE at the worksite without instituting a safety training program for proper use and maintenance of equipment. PPE will become ineffective when regular maintenance is not performed. Employees need to be informed of the shelf life of the equipment and that it is not good practice to store equipment (temporarily or permanently) in unclean work environments. Details about PPE training programs are obtainable through regional NIOSH or OSHA offices. Table 2 is a safety and health personal protective equipment checklist developed by the Women's Occupational Health Resource Center to assist in the assessment of effective PPE use at the workplace.

As discussed, there exists a need to expand and develop standards for PPE. While the adoption of new PPE standards will take time, it is incumbent upon employers and employees to ensure that current work practices are adequate and effective. Assurance of proper fit of appropriate PPE and the implementation of a PPE training program are two measures that could and should be carried out immediately.

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# Safety Hazards as Occupational Stressors: *A Neglected Issue*

**Barry R. Snow, PhD,** Columbia University, School of Public Health, New York, New York.

Occupational health nurses have traditionally been concerned with the provision of medical and supportive care for workers injured on the job. The articles in this issue are directed toward these professional concerns by reviewing the wide variety of potential safety hazards that exist in places where people work. Comparatively little systematic research or writing has, however, been devoted to the psychological and physical costs that work under these threatening conditions imposes. This neglect of the "hidden costs" of unsafe work exists despite the fact that 78% of the workers in a 1977 U.S. Department of Labor survey reported being exposed to at least one health and safety hazard on their job.[1]

The present article reviews the evidence that safety hazards may have a negative impact on the worker's physical and psychological well-being in addition to their potential for causing serious physical injury. This review will include experimental studies which extract specific aspects of the hazardous work environments and bring them into the laboratory for systematic examination. The limited number of field studies which examined the impact of safety hazards as occupational stressors will also be covered. A model of occupational stress which includes safety hazards as occupational stressors is then presented. Recommendations for the role of nurses in dealing with this relatively neglected source of occupational stress are made.

## EMPIRICAL EVIDENCE

Recent estimates by the U.S. Department of Labor show that for 1978, levels of occupationally related fatalities averaged 8.2 per 100,000 full-time workers while levels of occupationally related injuries were estimated at 9,200 per 100,000 workers.[2] These figures were found to be even higher in certain settings such as the mining industry. There are four major ways that long-term exposure to settings where accidents and injuries are common can have an adverse impact on the physical and mental well-being of workers. An analysis of these ways and existing empirical evidence for their impact follows.

The most straightforward way that hazardous environments can negatively affect one's health and well-being is by directly raising the physiological response level of the worker even before an accident occurs. Workers in unsafe settings need to pay constant attention to both the content of their work as well as to the process whereby they are carrying it out. They work in an environment where unpredictable and often uncontrollable hazards are present. A variety of laboratory studies have shown that dual demands for precision and vigilance — especially in settings that pose threats that cannot be anticipated or mastered — elicit a pattern of neuroendocrine and cardiovascular changes whose purpose is to mobilize the body for emergency action.[3,4] These changes have been labeled the "stress response" and include the release of the hormones adrenaline and noradrenaline, and an increase in blood

TABLE

EFFECTS OF STRESSFUL WORK CONDITIONS

PHYSIOLOGICAL
- Increased heart rate and blood pressure
- Increased catacholamines, corticosteroids, and glucose levels
- Dryness of mouth
- Sweating
- Faintness and dizziness
- Numbness and tingling in parts of limbs

HEALTH EFFECTS
- Skin rash
- Amenorrhea
- Headaches
- Insomnia
- Ulcers
- Chest and back pains

EMOTIONAL
- Anxiety
- Depression
- Boredom and fatigue
- Irritability
- Moodiness
- Emotional outbursts
- Loneliness

BEHAVIORAL
- Excessive drinking and smoking
- Excessive eating or loss of appetite
- Drug Abuse
- Restlessness
- Impaired speech
- Nervous laughter
- Trembling

ORGANIZATIONAL
- Poor productivity
- Inability to concentrate
- Absenteeism
- High turnover rate
- Poor organizational climate
- Job dissatisfaction

pressure and heart rate. Cox observes that these changes may improve work performance in the short run. The changes, however, are believed to be maladaptive in the long term and to lead to a state of exhaustion of bodily resources, giving rise to such stress-related diseases outlined in the upper portion of the Table.[5]

A second way that safety hazards may adversely affect the worker is by their direct effect on his state of mental health. It is generally agreed that the opportunity to exert some influence over one's environment facilitates adjustment and enhances coping effectiveness.[6] Conversely, long-term exposure to settings that are either not controllable or predictable may have widespread negative consequences, among which is a state of "learned helplessness." The state of learned helplessness has been defined as the condition where a person develops the belief that events and outcomes are independent of his actions.[7] A variety of studies have shown that feelings of helplessness play a central role in the etiology of depression. They are also believed to facilitate the development of a variety of other psychological and health outcomes. These outcomes, which have been labeled health strains, are outlined in the Table.

Workers in unsafe environments may be especially vulnerable to develop feelings of helplessness. Workers typically have had little input into plant design and operations. They routinely do not exercise the right to refuse hazardous work. Protective equipment, when available, may be ineffective or difficult to obtain. These events may help convince the workers that they are indeed powerless to intervene in their surroundings, and produce the variety of disorders that have been discussed earlier.

A recent study of the impact of the accident at Three Mile Island documents these psychological effects. Kasl et al.[8] compared the responses of workers at the TMI nuclear plant with those at a comparable nuclear facility. Workers were asked to rate their level of psychological distress and physical symptoms six months before the TMI accident, during the accident, and six months after the accident. Kasl et al. reported that TMI workers showed lower job satisfaction, greater increases in self-reported frequency of periods of anger, extreme worry, and extreme upset than did the workers at the control nuclear plant. Differences on perceived helplessness-hopelessness were also evident. It is, moreover, interesting to note that the direct influence of the nuclear accident may not have been limited to the TMI plant. Kasl et al. noted that workers in the control nuclear facility reported levels of worry that were significantly greater than those reported for the period six months prior. This increase was, of course, less than that reported at the TMI plant.

The physical symptoms that were reported were even more interesting than the psychological ones. Kasl et al. noted that TMI workers reported more physical symptoms of upset and distress such as headache, stomach troubles, and loss of appetite during the time of the accident than did control subjects. These symptoms, moreover, persisted six months after the accident had passed, indicating that work in such environments has a prolonged detrimental effect upon the health of the workers. These results are similar to those reported by Frankenhaeuser[4], who observed in her laboratory studies that the heavy physiological cost of trying to meet environmental demands is in part due to their aftereffects which persist for a long time after the environmental demand has passed.

The mental and physical costs which the demand for constant vigilance and perceptions of helplessness impose affect workers even in environments where no accidents have yet occurred. A third pathway whereby safety hazards exert an adverse impact may exist in settings where co-workers have already been either hurt or killed. Workers in these settings have firsthand evidence of the threat to bodily integrity which safety hazards pose. Such immediate proof of the danger of their work environments may lead to increased personal distress as well as contri-

bute to family tension over the workers' plans to continue at that job. Workers in the previously discussed TMI study indeed reported that they were more likely to experience conflict between what they perceived as their responsibility to remain on the job and their obligation to safeguard the health and well-being of their family by leaving the area. These conflicts may be especially common for occupations where the danger is more readily discernible than that associated with a nuclear accident of unknown nature.

A recent study by Duguay[9] provides some evidence in support of this position. Duguay analyzed injury and illness rates for different occupations and reported levels of job satisfaction in those settings. Workers in occupations with the highest injury and illness rates were found to have lower levels of job satisfaction than workers in safer industries. Duguay's figures on job safety and satisfaction, however, come from different years which make the relationship between these two factors difficult to determine. The impact of other occupational stressors that may affect worker satisfaction is also not considered. Her approach, however, is important, for it calls attention to the need to consider the psychological impact of immediate awareness of accidents in the group of factors that influence worker health and well-being.

Finally, immediate exposure to worker accidents affect health in a more indirect way. Kasl et al.[8] reported that TMI workers were more likely to take more drugs and drink more alcoholic beverages because of distress or tension associated with the accident than workers at the control plant. These findings are consistent with studies by Conway et al.[10] and others that stress increases the frequencies of behavior that are positively reinforcing in the short run (e.g., cigarette smoking, drug consumption) but increase the long-term risk of illness.

One should note that the present analysis views both the threat of and actual experience with industrial accidents as a negative influence upon the worker's health and well-being. The role of the worker in contributing to the accident has not been considered. A variety of occupational health and safety writers have advanced the notion that accident proneness is a substantial factor in accident causation. This belief maintains that although all workers are exposed to equal risk, some workers have a higher accident rate than others due to some inherent personality characteristic. The present review agrees with Sass and Crook's recent analysis[11] that accident causation must be viewed in terms of the entire context of the work setting. Where workers lack the ability to act independently to control work hazards and to regulate their work process, the worker is best described as a reactor to rather than the initiator of the unsafe act. An analysis of the role of safety hazards as occupational stressors should, therefore, regard the person as one who is trying to cope with rather than responsible for introducing the safety hazards into the workplace. A theoretical model of stress which adopts this position is presented in the next section.

## DEFINITION OF STRESS

A broad concept of stress, which has been called the interactional approach, has been developed by Lazarus.[12] This concept represents an evolution from earlier models of stress which emphasized either characteristics of the environment or the responses of the individual. According to this formulation, individuals are constantly involved in an exchange of information between themselves and their environment. Stress exists when an individual evaluates his environment as containing hazards ("stressors") that pose a significant threat to his health and well-being. Lazarus maintains that once a situation is assessed as stressful, a process of secondary appraisal is initiated. Having evaluated the situation as dangerous, people turn their attention to the costs and benefits of different modes of coping with the perceived threat. These modes may include direct action to alter the nature of the stressor, escape from the stressful situation or a variety of internal, palliative changes such as relaxation, denying the existence of the stressor or using drugs.

The interactional approach expands on earlier approaches to stress in a number of ways. This interactional approach recognizes that the threat of harm may occur in anticipation of external events that never come to pass. It, moreover, maintains that the stress response that is induced may last longer than the environmental threat, and evoke a more potent psychological and physiological response than the actual confrontation of danger by the individual would have produced. Finally, the interactional approach emphasizes the role that environmental threats have in encouraging coping behavior that may be, in the long run, self-defeating for the individual. This approach to stress has, however, usually been used to explain the impact of acute stressors such as illness, injury, and death. Lazarus and Cohen[13] recently pointed out that such a model may also be useful for such long-term stressors as work overload, air pollution, and neighborhood crowding. The present paper argues that this is especially relevant to the understanding of the impact of working in hazardous work environments.

## RECOMMENDATIONS

Occupational health nurses should familiarize themselves with stress-related symptoms and the interactional model of occupational stress presented earlier. This information will help sharpen their recognition of the many ways in which safety stressors can affect the health and well-being of workers. It would also alert them to the potential role that occupational factors such as job related tension may have in contributing to a wide range of physical and mental strains. Recognition of this association between the work setting and such outcomes as headaches and increased drinking may help prepare nurses to provide more comprehensive supportive care programs for workers under their professional charge.

Next, occupational health nurses

should acquire training in the major kinds of safety hazards and the techniques available for their elimination and control. This information would allow them to identify potential hazards in their workplace, become familiar with existing personal protective equipment, and determine whether alternative methods for performing specific tasks exist. Nurses should make this information available when providing individual care. Plant rounds, formal education courses, and clearly designed posters are also tools that may be appropriate in certain settings. These activities should help reduce the frequency of such common causes of disability as back injuries, slips and falls, and falling objects. The provision of such detailed information may also help reduce the tensions associated with working in these environments. It would also give workers an opportunity to develop a sense of mastery which is crucial to one's psychological health.

Finally, nurses should seek to become a member of the company's safety committee or other such corporate body. In this capacity, they can work cooperatively with safety experts and industrial hygienists to make recommendations for the redesign of work areas so that specific tasks can be performed with maximum safety. The occupational health nurse brings to this area a variety of skills. She or he alone may have the rapport with employees that allows one to determine both the physical and psychological impact of the work setting upon the individual.

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# Improving Safety and Health Through Collective Bargaining

In the ongoing efforts to improve health and safety conditions at their workplaces, a very effective tool for the organized worker is the union contract. A well-researched and well-written collective bargaining agreement containing health and safety clauses can work on two levels to help provide a safer and healthier work environment. On one level, effective contract language can set up the framework for extended union-management cooperation. This can enable employer and employees to work together to improve conditions. On a second level, well-developed contract language sets minimum safety standards, obligates the employer to provide first-aid services and safety equipment and commits the employer to a general policy of concern about safety and health and also empowers and obligates the union to represent its members more fully in this area. I shall discuss several aspects of model contract language.

The basic starting point for introducing health and safety language into a contract is the general duty clause which minimally commits the employer to providing a safe workplace and to obeying all recognized health and safety standards. This is, however, not the limit of a general clause which can accomplish still more. For example, some agreements include employer endorsements of the ideal of a healthy and safe work environment. A 1976 agreeement between the New York Lamp & Shade

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Manufacturers' Association, Inc. and the International Brotherhood of Electrical Workers included this far-reaching commitment:

> Safe, healthful and otherwise satisfactory working conditions shall be provided for all employees, which conditions shall comply with the highest standards respecting sanitation, cleanliness, light and safety.[1]

More modest safety clauses, like this one from a recent collective bargaining agreement between United Professional for Quality Health Care/ 1199 and the State of Wisconsin, Department of Health Services, may be open to broad interpretation:

> The Employer shall observe all applicable health and safety laws and regulations and will take all reasonable steps necessary to assure employee health and safety... All unsafe or unhealthy conditions shall be remedied as soon as is practicable.[2]

When the workers covered by this agreement were dissatisfied with their employer's compliance they filed a grievance, another right contained in their collective agreement. The grievance by the registered nurses at the Northern Center for the Developmentally Disabled was settled in the nurses' favor and new overtime and staffing provisions were put in place based on an interpretation of the clause. The grievants had claimed that their employer's pledge to remedy conditions that were unsafe for employees and/or patients included unsafe conditions caused by understaffing. The grievance finally made its way to an impartial arbitration decision which ruled in favor of the nurses. (The right to seek a decision by an outside arbiter is another contractually agreed upon process.)

This arbitration ruling is based on the fact that in most job situations, understaffing means overwork, overwork means stress and usually unsafe acts and conditions. For example, understaffing can lead to conditions where personnel must lift patients unaided, leading to back injuries. Other instances are discussed by

Stellman in this issue. In recent years, new information about the damaging physical affects of stress have made stress reduction an important occupational health goal. Some union contracts make specific reference to staffing, crew size and job responsibilities. Nurses at Hurley Medical Center in Michigan have a contract that recognizes the need for auxiliary health personnel, defines the nurse's authority and responsibilities and agrees that "it is the Medical Center's responsibility to provide adequate nursing and auxiliary personnel."[3]

The collective bargaining agreement can also provide more traditional safety measures. It is common for contracts to include provisions for employer supplied safety clothing and equipment. Other collective agreements set safety standards for sanitation, housekeeping, noise levels, ventilation, lighting and radiation exposure. Some jobs may warrant contract language that spells out specific protective measures, such as guards and safety controls on machinery, protection from electrical hazards and special ventilation to avoid the risk of fire.

Occasionally an employee may find himself/herself asked to do work that she or he believes will be very dangerous. Collective bargaining language can protect the worker in this situation. Many contracts include a provision which enables a worker to refuse to perform work which is clearly hazardous. However, the definition of what constitutes "imminent danger" to the worker must be hammered out in contract negotiations. A 1976 contract between the State Council of Freezer Unions (Teamsters) and the Frozen Foods Employer's Statewide spelled out the conditions which warranted such action:

> It shall not be a violation of any provision of this contract for employees to refuse to: 1) start work, 2) return to work, or 3) continue working, when any condition exists which would endanger the employee's health, safety, or well-being, and such employees will not be subject to discharge or disciplinary action.[4]

The contract can also protect the employee's health by affirming the employer's commitment to first-aid and medical care. Management health programs can range from first-aid stations to periodic physical check-ups and monitoring. Many agreements included free transportation to medical care in case of an emergency.

## COOPERATION

Just as the general health and safety clause sets the stage for all contract language providing physical protection, it is also the first step in building a union-management framework for cooperation. This process begins in contract negotiations. During the discussions about the language of the general clause, the union negotiator can begin to convince the employer of the union's commitment to both safety and cooperation and vice versa. Most general health and safety clauses include both union obligations and employer responsibilities. Typically, the union and employees agree to obey all rules and regulations pertaining to health and to report unsafe conditions to management. This is a first step toward cooperative efforts for health and safety.

A second important step is the agreement by union and management that all health and safety disputes will be resolved through the standard grievance procedure. In one sense, the grievance machinery is the very opposite of cooperation: it is a refereed fight between two opposing parties. However, the grievance procedure can also be considered a framework which enables the disputing parties to resolve their differences without dissolving their cooperative alliance. Some contracts even provide an abbreviated grievance procedure for health and safety disputes. Many United Auto Workers contracts reserve health and safety disputes as the only legal cause for a strike while the contract is in force.

Good union-management cooperation is usually promoted by the joint safety committee. A union-management safety committee can serve as a watchdog for hazards in the workplace and can oversee the enforcement of health and safety improvements. Many unions maintain independent safety committees as well, just as management has its own safety team. The contract spells out the composition of the joint committee (usually three representatives each from labor and management) and lists its functions and responsibilities. Some agreements include provisions for employee-members of the joint committee to be paid for time spent off the job on committee business.

Finally, in order for the union to represent the employees effectively, it is important that the collective bargaining agreement stipulate certain union rights. The union must have the right to monitor the workplaces where members suspect health and safety hazards. The employer must agree to supply the union with all the information he has on: accidents, illnesses, medical test results, the toxicity of any chemical used on the job (including new medical findings) and exposure to disease or radiation.

Most importantly, the union and the employer must agree to cooperate on health and training for all employees. Whether the education program is designed by the employer, the union or jointly, both must cooperate in its implementation. The end result, informed and aware employees, can only mean a safer and healthier workplace.

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Health and safety hazards are largely unexplored and understudied in the female intensive occupations. This lecture is intended to train occupational health nurses (OHN) in the identification of cancer hazards that exist in the segregated work environment of many women workers. In particular, the cancer risks faced by health care workers, clinical and research lab technicians, and textile workers will be discussed in detail and presented as case studies. Methods for determining the relative cancer risks to women workers and an inventory of health and safety resources will be provided.

2. Stress In The Workplace

The past several decades has seen a shift in the major sources of ill health from acute infectious diseases to chronic diseases. This shift has increased the importance of preventive efforts which look beyond the biological causes of illness to environmental and psychosocial forces that affect health. This lecture is designed to familiarize the OHN with the major sources of stress in the workplace and their impact on health. Methods of assessing workplace stress and intervening at different points in the stress and disease cycle will be discussed.

3. Carcinogens In The Workplace

The inherent cancer risks of any particular workplace is difficult to assess on a precise scale, as each year an additional 1000, largely untested, chemicals are introduced into the workforce. The emphasis of this lecture will be to equip the OHN with the appropriate information and skills necessary for developing a comprehensive cancer control program in their individual workplaces. Chemical containment and substitution practices, work process isolation techniques, and personal protective equipment and worker training programs will be discussed as remedial approaches to cancer hazard abatement.

4. The Cancer Patient Returns To Work

An examination of the OHN's own attitudes and beliefs regarding the capabilities and limitations of the cancer patient in the workplace is initially presented in this lecture. Followed by an overview of some of the psychosocial and medical issues faced by the cancer patient and the impact of the cancer patient's return upon the fellow employees. Workplace interventions to facilitate positive reentry into the workplace for the employee will be discussed.

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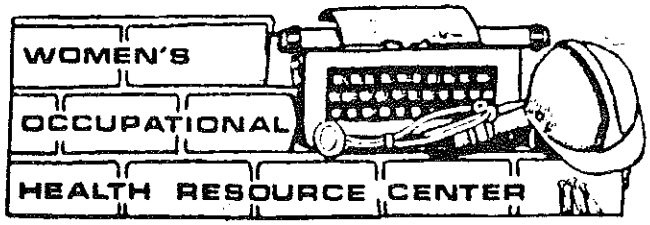


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# PUBLICATIONS LIST

## BOOKS:

WOMEN'S WORK, WOMEN'S HEALTH, by Jeanne Stellman, Ph.D., Pantheon Books, 1977. Dispels the myths surrounding women and work. Useful information on the health hazards found in the ten occupations where most working women are found. $5.95

REPRODUCTIVE HAZARDS IN THE WORKPLACE: A COURSE CURRICULUM GUIDE, by Wendy Chavkin et al., published by NYCOSH, 1981. A course curriculum for workers with references, and sample reproductive history questionnaire. $3.00

STRAINS & SPRAINS, by Dan McLeod, U.A.W. Health & Safety Department. 36 pp 1982. This booklet examines the stresses to wrists, arms and backs due to poor job design and discusses workplace remedies. $2.00

BIOLOGICAL WOMAN-THE CONVENIENT MYTH, edited by R. Hubbard, M.S. Henifin and B. Fried, published by Schenkman Publishing Co., 1982. Collection of feminist essays, with comprehensive bibliography on women, science, health and occupational health. "No Fertile Women Need Apply", discusses employment discrimination and reproductive hazards in the workplace. New and revised material since previous edition Women Look at Biology Looking at Women. $11.25

WORK IS DANGEROUS TO YOUR HEALTH, by Jeanne Stellman, Ph.D. and Susan Daum, M.D., Pantheon Books, 1973. A handbook of health hazards in the workplace and what you can do about them $4.95

HEALTH PROTECTION FOR OPERATORS OF VDTs/CRTs, by Tobi Bergman with the assistance of the NYCOSH VDT/CRT Work Group. Includes information on health hazards and their identification and prevention. $1.00

HEALTH OF WOMEN AT WORK, a bibliography by Vilma R. Hunt, Program on Women, Northwestern University. A comprehensive bibliography including references on women in the workplace as well as specific occupational health hazards. $6.00

WOMEN'S WORK IS...RESOURCES ON WORKING WOMEN, edited by Bobbi Wells Hargleroad, published by the Institute on the Church in Urban-Industrial Society, 1978. A thorough bibliographic reference covering all aspects of women in the workplace. $4.00

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REPRODUCTIVE HAZARDS FACTPACK, includes articles on "the effects of toxic agents on reproduction, "The Pregnancy Discrimination Act," genetic testing by industry and its implications in hiring practices, references on reproductive hazards in the occupational environment and more. $3.00

NITROSAMINES AND OTHER HAZARDS IN THE MACHINE SHOP describes the potential hazards from exposure to nitrosamines, with special emphasis on those used in cutting oils. A detailed discussion of other machine shop hazards, their effects and preventive measures are also included. $1.00

SOME FACTS ABOUT PHOTOCOPIERS reviews potential chemical hazards associated with the use of photocopiers, with short sections on the effects of noise and bright lights. $1.00

PERSONAL PROTECTIVE EQUIPMENT FACTPACK. Includes facts on workclothes and personal protective equipment used by women working in both traditional and non-traditional roles in the trades. Suggested sources for obtaining properly fitted personal protective equipment and a list of manufacturers is included. $ .50

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