



Prevention

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General Principles

Prevention of work-related health complaints should be a top priority for occupational health providers. Diagnosis and treatment of workers presenting with work-related injuries and illnesses represent an opportunity for providers to help prevent recurrences in these workers (tertiary prevention); mitigate the effects of current work-related hazards so as to reduce the severity and duration of disability (secondary prevention); and prevent the same injury or illness in coworkers and those in similar jobs (primary prevention). The workplace also presents opportunities for the prevention of non-work related health issues through the screening of employees for chronic disease risk factors and through health promotion programs designed to motivate and support responsible health choices.

Occupational health providers can often identify opportunities for prevention. For work-related health complaints simply understanding the job (and work) requirements may suggest possibilities for primary prevention of illness or injury through hazard identification. A workplace walk through is often useful to allow attainment of familiarity with job requirements and the work environment as one element of fitness-for-duty assessment, as well as with the identification of hazards. The discovery of significant work factors suggests that worksite intervention to prevent recurrences injury or illness and/or hasten recovery may well be appropriate.

A cluster of cases in a work group suggests a possible relationship to potentially unidentified problems in work design or management, particularly if the outcome is rare. The presence of work-related discomfort, illness, or injury should trigger a search for causes (see Work-Relatedness chapter) and plans for remediation when feasible. Different levels of certainty about the cause of the problem and differences in severity of the adverse health effects may justify different levels of response.

The occupational health provider's task in prevention is to first identify associated or causative workplace and personal factors and then suggest evidence-based screening of personnel and selection of appropriate controls (i.e., administrative, engineering, and/or work practice) as well as task or job redesign. Screening of potentially serious conditions such as asbestosis, silicosis, occupationally related cancers and similar conditions is generally considered mandatory. Screening for auditory impairments is required for high noise exposures. Screening for musculoskeletal disorders (MSDs) is of unclear benefits as the number of workers affected, whether exposed to high job physical factors or not is often overwhelmingly high affecting more than half of the workforce in a year, thus caution is warranted in attempting screening and interpreting results for MSDs.

Treatment and disability management of the immediate health problem should be carried out. Further preventive efforts may include instituting use of personal protective equipment, administrative changes, education, and training at all levels of the company. In addition, close attention to the psychological needs of employees, proper medical surveillance of the workplace, and the opportunity for contact with a health care provider if questions or complaints arise is necessary. Whether the job is a match with the physical, cognitive, and/or psychological capabilities of the individual worker often requires investigation. There is enough variation in strength, flexibility, endurance, healing capacity, anatomy, and other factors among workers that individual investigation is warranted because statistical risks apply only generally to individuals (see Person-Job Fit).

Evaluating the Evidence for Preventive Action: Causation and Association

DIAGNOSIS: KEY TO ANALYZING ASSOCIATION

The first element in seeking an association between a work-related health problem and a worksite factor is an accurate diagnosis. Epidemiologic studies generally correlate exposures particularly to a combination of risk factors (e.g., forceful exertions, repetition) with specific pathologic entities. Alternatively, some studies have correlated levels of symptoms rather than diagnoses with worksite exposures or tasks. These correlations are useful to help prevent health-related complaints, but increased frequency or intensity of symptoms alone should not be equated with causation or potential prevention of specific pathologic entities (e.g., diagnoses) such as carpal tunnel syndrome, disk herniation or occupational asthma for example. A careful search should be made for the appropriate diagnosis.

USE OF QUALITATIVE INFORMATION

Occupational health physicians making recommendations for prevention of work-related complaints are still faced with a lack of quantitative associative information for many common problems. An individual worker's symptoms alone may decrease productivity and cause discomfort. As such, physicians are obligated by public health principles to mitigate the symptoms, to hasten recovery and help prevent recurrences in the individual as well as help prevent occurrences in other workers when feasible. Such actions often must be taken on a case-by-case basis integrating quantitative information where available on the worker-job fit and preliminary or population data (e.g., rates of disease in the population, or a comparable population).

The current scientific literature about potentially work-related musculoskeletal disorders (WRMSDs), degenerative disorders such as degenerative joint or disk disease, and a number of other nonspecific symptoms and conditions (e.g., visual fatigue, commonly known as eye strain, and associated headaches and neck and shoulder complaints, stress-related complaints, nonspecific chest pain, respiratory symptoms thought to be due to indoor air pollution, and others) is notable for the lack of studies that temporally and quantitatively define causal associations of work exposures. There are very few prospective studies on these disorders and symptoms (most of the studies are cross-sectional or case-control which does not allow for determination of a temporal association and causality). Other information is derived from physiology, biomechanical, toxicological, or other laboratory measurements rather than clinical observation in real work situations and as such is difficult to apply in the occupational setting.

Further, most available studies either define exposure to work-related factors qualitatively or use job title as a proxy for exposure. Generally, there is no quantification of specific ergonomic, toxicological or other stressors to allow determination of a dose-response curve (see Work-Relatedness chapter). If there were dose-response relationships, one might find thresholds at which WRMSDs and other work-related symptom complexes might or might not occur. Thus, at present, few risk factors have been found to be predictive of certain WRMSDs and other syndromes. Due to the absence of certainty regarding causality and the lack of quantitative exposure-response data, most recommendations for the prevention of WRMSDs are qualitative. While occupational health physicians make good-faith efforts to prevent these complaints, these assumptions should not extend to opinions about causation for benefits or medicolegal purposes. As such, the commonly seen statement "in the absence of other obvious causes, the problem is work-related" is at odds with scientific logic (evidence based medicine) and should not be used (see Work-Relatedness chapter).

COMPLEX CAUSATION

The occupational health physician should also be aware that many musculoskeletal, respiratory, audiological, psychological, and other problems are often caused by work- and non-work-related or personal factors in varying combinations. Many potentially work-related complaints result from more than one factor with some, if not most, disorders representing manifestations of interactions between those risk factors. The work factors may be necessary, but not sufficient to develop the disorder. For example, not all workers exposed to certain numbers of repetitions and degrees of force during hand manipulations will develop tenosynovitis of the wrist and hand, but a few of them may develop the problem without significant ergonomic exposure at work or during performance of non-job-related daily activities or a hobby. In other cases, there may be a variety of possible contributing factors for a disorder or complaint as well as personal and work factors that interact. For example, pregnancy, hypothyroidism, or obesity may be associated with carpal tunnel syndrome (CTS) in susceptible individuals (although the symptoms may occur mostly while the individual is at work for some). Population studies have identified such competing causes in a number of instances (see Work-Relatedness chapter). Both work and personal factors may also need to be addressed to prevent initial episodes, delayed recovery, or recurrences.

ACUTE vs. CHRONIC SYMPTOMS

Many if not most disorders become manifest at a point in time and thus appear to be acute. However, for most MSDs, there is evidence that the common disorders are manifestations of underlying degenerative conditions. Thus, the manifestation of symptoms may be irrelevant to the determination of work-relatedness (see Work-Relatedness chapter). For example, CTS most commonly manifests itself at night whether there are or are not

significant job physical factors. Also, some occupational pulmonary symptoms do not occur at work though the exposures did.

Additional challenges include exacerbations or aggravations of underlying conditions. These are difficulties that are handled differently in different jurisdictions and are beyond the scope of this chapter; however, it is incumbent on the provider to be well versed in those definitions and distinctions. Some of those situations involve significant exposures that may benefit from an ergonomic or industrial hygiene evaluation to ascertain whether occupational factors may be significantly contributing to the manifestation of symptoms.

PERSON-JOB FIT

Ensuring proper person-job fit is important to prevent discomfort, loss of productivity, and physical injury to workers. Workers vary in their capacity to lift, exert force, perform fine motor tasks, etc., according to factors such as general/specific health status, age, conditioning, size, strength, and psychosocial status. Workers' physical functional abilities rise and fall over their lifespan. Physical abilities also vary from worker to worker depending on conditioning, impairment, and innate capacity. The decline in cardiorespiratory and musculoskeletal functional capacity with age can be delayed or accelerated by physical conditioning (or lack thereof), illness (including chronic pain), and injury. The visual system also undergoes predictable and anticipated changes during an individual's lifespan. Natural hyperopia (far-sightedness) tends to lessen or to transition to myopia (near-sightedness) at approximately 20 years of age.ⁱ Similarly, the auditory system also declines with age.

FITNESS-FOR-DUTY EVALUATION: ASSESSING PERSON-JOB FIT

Occupational physicians are often called on to determine person-job match, sometimes termed "fitness for duty." To determine fitness for duty, it is often necessary to medically gauge the capacity of the individual (one consideration is function-based testing, including functional capacity evaluations) compared with the objective physical requirements of the job based on the safety and performance needs of the employer, expressed as essential job functionsⁱⁱ that are ideally quantified. However, an objective statement from employers regarding the physical requirements of the job with sufficient detail is usually not available. As such, this assessment may out of necessity be performed without complete workplace information. Further, as noted earlier, studies correlating physical testing with risk of complaints or injuries often are not validated or not available.

The fitness-for-duty evaluation must address a continuum of historical and physical findings from reports about occasional symptoms of musculoskeletal discomfort to a definitive diagnosis of a significant musculoskeletal disorder that may functionally limit the individual. The challenge is to fairly and accurately evaluate the individual for fitness to perform the job, often not on the basis of quantifiable risk but on professional opinion regarding what the worker can or cannot do.ⁱⁱⁱ The worker's past history of pain or dysfunction in specific work settings is useful in gauging the probable reaction to occupational factors (e.g., job physical factors, respiratory exposures, psychosocial stressors, etc.). For patients whose work entails significant physical labor, a change in career or work duties may be necessary in the event of a decline in functional capacity with age or other factors. Providers should carefully assess whether employees can tolerate a given job or work environment, particularly when symptoms or difficulties arise. Large employers may also assess work capability and tolerance as part of a pre-employment process especially if a job requires a certain level of physical or mental conditioning. Employers who consider worker-job fit may be able to prevent or reduce both injuries and modulation of pre-existing symptoms. In the case of age-related capacity, one initial step is to identify particularly demanding jobs that are unlikely to remain suitable for employees until retirement. In identifying such jobs, be cognizant of quality evidence of increased incidence of symptoms or of injury with age, if it exists. In many cases, such evidence does not exist (see Work-Relatedness chapter). Speculation should be avoided, although occasionally, recommendations are requested to

ⁱIt takes 3 diopters at the near point of accommodation to keep a target at 1 meter in focus. Infants have natural hyperopia of 2 to 30 diopters; by age 10, the amplitude of accommodation is 14 diopters, declining to 4 diopters at age 45, and 1 diopter at age 60.

ⁱⁱAn essential job function is a mandatory requirement of the job that the employee must be able to perform. Some essential functions may be accomplished by implementing different techniques such as alternate work practices, planning, or adaptive equipment.

ⁱⁱⁱThe U.S. Equal Employment Opportunity Commission is re-interpreting fitness-for-duty, post-offer, and pre-placement screenings based on amendments to the Americans with Disabilities Act and case law. See www.eeoc.gov/policy/docs/guidance-inquiries.html.

be made without quality evidence. The next step is to discuss these issues with the company and the involved employees and to anticipate the need for long-term succession plans to shift duties as workers age.

PSYCHOSOCIAL FACTORS AND PERSON-JOB FIT

Employees who are invested in remaining at work will generally try to overcome obstacles resulting from work intolerance, perhaps by adapting or changing work practices to their abilities. Workers who are experiencing other forms of job-related dissatisfaction and other psychosocial stressors are believed to be less likely to seek to match their abilities to work demands.

Preventive Strategies and Tactics.

Different strategies may be employed in an effort to prevent first episodes of symptoms or activity limitations, recurrent episodes, chronic disability, lost workdays, medical care utilization and their associated costs. As these are somewhat disparate outcomes, it is recommended that occupational health professionals should be clear about the goals of specific preventive efforts.

Primary Prevention

The primary prevention of work-related disorders depends on the reduction or elimination of exposures to factors causally associated with those disorders in individuals susceptible to such stressors. In the past, emphasis has been placed on risk factors that are physical in nature, such as force, repetition, posture, vibration, lighting, terminal design, posture, aeroallergens, chemicals, noise, and electromagnetic radiation. However, other factors, such as worker job satisfaction and relations with coworkers and supervisors, have been specifically noted to have a relatively strong relationship to musculoskeletal, ergonomic, visual, cardiovascular and respiratory disorders. The primary prevention of work-related complaints thus ideally depends on reducing all relevant exposures, whether physical, personal, chemical and/or psychosocial stressors.

WORK DESIGN

Several general principles are important to prevent musculoskeletal disorders, occupational pulmonary disorders, visual fatigue or injury. These include protection from hazards via engineering controls, use of personal protective equipment, administrative controls (i.e., policies, procedures, training, supervision, and scheduling to reduce exposures), and person-job fit/fitting the job to the worker. Person-job fit is a basic principle that may markedly reduce occupational health concerns and the costs of lost productivity due to illness and injury as well as related medical costs. The same principles are used either to engineer jobs so that they fit many people or to adapt a job, task, or workstation to a specific person. These principles include:

- Decreasing high or moderately high force or loads, high repetition rates, and high durations of exertions through redesign, tool changes, or automation.
- Decreasing static exertions that result in excessive muscle fatigue.
- Providing reasonable and prudent exercise breaks depending on the tasks involved (e.g., stretch or light-exercise breaks every half hour or hour when significant static, repetitive, or sedentary jobs or tasks are performed). Breaks may include “micro-breaks” (short intervals where physical work is not required). Frequencies and durations of breaks are generally directly proportional to the degree of the preceding levels of job physical demands.
- Avoiding use of the hand as a tool, such as pounding on a tool or part.
- Providing lift-assist devices, particularly for tasks requiring performance of frequent, heavy lifts.
- Positioning work to avoid static, nonanatomic postures resulting in sustained muscle contraction.

Jobs and workstations should be designed so that they fit most workers’ capacities when feasible. Workstations, equipment, or task components should, when possible, be adjustable for workers of different stature, strength, and endurance to ensure a match between each worker and his or her tasks, thereby avoiding discomfort, loss of productivity, and injury. Work organizational factors and other psychosocial factors may also need addressing, particularly if there is job dissatisfaction or other psychosocial stressors. Jobs are thought to be best designed to

include worker control over tasks where possible, variability in job tasks, ability to take microbreaks or manage time, and provide input to improve workplace practices and procedures.

Ergonomic Tactics to Prevent Distal Upper Extremity Musculoskeletal Symptoms and Disorders

In making recommendations for the design of tasks and workstations to prevent distal upper extremity musculoskeletal symptoms and disorders, the occupational health provider should be aware of the physical dimensions and range of motion needed to complete the tasks involved. Tools, machinery, or workstations should ideally be flexible enough to accommodate any worker. It may be helpful to involve workers in the identification of physical job requirements and of potential uncomfortable or overload situations. This can be accomplished through interviews, group sessions, and/or questionnaires and scales. Ergonomic research suggests the following recommendations for the design of tasks that involve use of the distal upper extremities in order to prevent musculoskeletal complaints and injuries:

- Design of hand tools should be determined by hand anatomy and task design in order to:
 - Maximize grip strength by avoiding palmar flexion and other wrist deviations.
 - Provide as great a force-bearing area as possible in handles and grips.
 - Minimize the force and vibration transmitted to the hand and upper body.
 - Avoid repetitive finger action.
 - Avoid ulnar or radial deviation or flexion or extension at the wrist.
- Tools that help reduce the force to accomplish the job should be trialed by workers, and if successful adopted.
- Machinery should be maintained to reduce hand forces required.
- To avoid neurovascular as well as tendon injury, the hand should not be used as a hammer.
- Vibration transferred to the hands, wrists, and remainder of the upper extremity should be reduced to the extent possible through the use of vibration-damping wrappings and coatings, isolation suspension of vibrating machinery, or automation.

Ergonomic Tactics to Prevent Shoulder Musculoskeletal Symptoms and Disorders

The following are ergonomic principles and recommendations for prevention of shoulder disorders (also see Shoulder Disorders chapter). Ergonomic research suggests the following recommendations for the design of tasks that involve use of the shoulders, and upper extremities in order to prevent musculoskeletal complaints and injuries:

- Reducing the weight of the object is believed to be most important.
- If the job requires overhead use and the object or tool cannot be lowered to less than 60° of forward flexion, then lowering the object to 90 to 120° of forward flexion is believed to be inappropriate and may inadvertently increase risk.
- Tools that reduce force requirements may be helpful (see above recommendations for distal upper extremity MSDs).
- Sustained postures producing static use should be avoided, particularly in 90 to 120° of forward flexion (see Shoulder Disorders chapter).

Ergonomic Tactics to Prevent Neck and Back Musculoskeletal Symptoms and Disorders

Ergonomic research suggests the following recommendations for the design of tasks that involve use of the back to prevent musculoskeletal disorders and injuries. There is little evidence for neck disorders, which are assumed to have similar recommendations. The National Institute for Occupational Safety and Health (NIOSH) has issued the following lifting recommendations¹:

- Lifting should be planned to avoid slippery and cluttered areas. Objects lifted are generally recommended to be:
 - Close to the body (low horizontal distance).
 - Between knee (preferably waist) and shoulder height.

- Lifted without bending or twisting the back (if the object is too large to fit between the knees, then there is *less* back compressive force with bending the back and not the knees with lifting).
- Lifted with the chin tucked in, if lifting overhead.
- Well-designed with secured handles (if used; alternately, some objects have good natural hand holds).
- Less than 50% of a worker's capacity (personal strength limits) as determined by preplacement testing.
- Generally less than 25 to 35 pounds (11.3 to 15.8 kilograms), unassisted (this may vary considerably from worker to worker and between genders).
- Lifted less frequent than 20 lifts per minute depending on lifting technique, physical conditioning, and personal factors.
- Raised with slow, controlled lifts with at least 3 seconds per lift.
- Lifting devices may be helpful to reduce lifting demands.
- Pushing and pulling should be limited to forces of less than 50 pounds (22.5 kilograms) at the hands.
- Heavy carrying should be reduced to less than 33 percent of lean body weight by:
 - Dividing loads.
 - Using mechanical transport devices.
 - Using more than one worker to move heavy loads.
 - Tailoring tasks assigned to each worker and load size.
- The use of back belts as lumbar support should be avoided because they have been shown to have little or no benefit (see Low Back Disorders chapter), and provide only a false sense of security.
- Unexpected movements should be avoided by:
 - Ensuring strong, easily gripped, thick handles with rounded edges.
 - Removal of slip, trip, and fall hazards.
 - Planning lifting maneuvers.
- Prolonged sitting and standing should be reduced by:
 - Providing rest and exercise breaks.
 - Task rotation or variation.
- Twisting and bending while bearing a load should be avoided by correct placement of work materials.
- Reaching outside the preferred work area should be avoided through placement of work materials within approximately a 90° arc centered in front of the worker.
- Whole-body vibration (particularly high amplitude, low frequency as may occur with some motor vehicle and machinery operation) should be reduced when feasible by:
 - Mechanical damping or balancing of machinery.
 - Damping cushions and padding.
 - Automating processes.
- The level of exertion should be limited to about 33% of a worker's aerobic capacity. This may also be determined by preplacement testing.
- Seating height should generally be at 16 to 20 inches (40 to 52 centimeters) with a lumbar support, adjustable reclining back (90 to 140°), and a firm, flat, adjustable seat pan with a rounded edge no longer than 16 inches (40 centimeters) for prolonged sitting. Mobile workers may prefer a sit-stand option using a high stool with a seat 29 to 32 inches high (74 to 81 centimeters). Seating of the first type and sit-stand stools support back musculature and minimize intradiscal pressure. Foot rests and/or armrests may be needed for some workers. All seating should be fully adjustable to accommodate workers of different heights and body habits.

Psychosocial Factors

The following are methods by which psychosocial factors may be reduced to improve job satisfaction and task enjoyment:

- Varying repetitive or monotonous work by considering automatic feed devices; task, job, or worker rotation; or breaks, mini-breaks, and exercises.
- Increasing workers control over tasks.
- Designing jobs so that employees see the output of their work.
- Increasing workers participation in decision making.
- Matching authority and responsibility in jobs.

Ergonomic Tactics to Prevent Visual Fatigue and Other Visual Disorders

“Visual fatigue” is a term used to describe phenomena related to intensive use of the eyes (see Eye and Vision chapter). It can include symptoms of eye or periocular pain, itching or burning, tearing, oculomotor changes, focal problems, performance degradation, “aftercolors,” and other phenomena. To prevent visual fatigue, ergonomic research suggests that:

- Frequently used displays be placed in the primary visual display area – the top of this area should be opposite or slightly below the operator’s eyes with eyes facing straight forward, extending down to a point where the operator is looking down at a 30° angle. Devices viewed as they are operated, such as buttons, keyboards, and controls, should be above and below this area, at the work surface, and above the plane of the operator’s eyes.
- The optimal viewing distance for visual displays is about 20 inches (50 centimeters). Corrective lenses designed specifically for fine details, including display-screen work, can be used for workers with refractive error or presbyopia. Lenses of this type can be incorporated into multifocal eyeglasses.
- Proper illuminance is important and should be evaluated for each task. It depends on the task, reflectance of surfaces in the area, and to some extent the age of the worker (older workers generally require brighter lighting with less glare for visual discrimination). In general, luminance of 70 to 80 footcandles is needed for general office work, 100 to 150 footcandles for visually intensive tasks, and up to 500 to 1,000 footcandles for very fine tasks. When needed, specific task lighting is preferred over excessive ambient area lighting.
- Lighting geometry should be configured to avoid glare. Glare should be reduced for display terminals by:
 - Placing visual display terminals out of direct line with windows.
 - Use of window films and coverings.
 - Use of dull textured surfaces.
 - Reducing ambient lighting to below 500 lux (18 to 46 footcandles) and using supplemental lighting when needed.
 - Use of indirect lighting.
 - Parabolic louvers on fluorescent lights.
 - Shielding of auxiliary lighting.
 - Use of eye shades.
- Visual discomfort from glare and other sources cumulates during the workday, so task rotation may be a reasonable preventive measure if other measures are not possible or reasonable.
- Visual performance can be impaired by whole-body vibration in the range of 10 to 25 cycles per second. Such vibration, which may be generated by power saws, cranes, conveyors, and other machinery, should be damped or separated from the worker. Periodic short periods of rest from fixed focal tasks for data-entry workers and other computer-related positions, such as a 5-minute period involving fixation of the eyes to infinity every 20 to 40 minutes, helps to reduce eye strain and discomfort while improving mood and performance.

PERSONAL RISK MODIFICATION

Employers have been increasingly implementing worksite health promotion initiatives over the last 25 years^{2,3} in an effort to help modify individual personal risk factors of workers as there is increasing recognition they are important risks for many occupationally-related disorders including MSDs (see work-relatedness sections in each chapter), as well as non-occupational disorders that increase health care costs. The general health of the worker

also potentially affects their ability to perform at work optimally and as such should be of concern to the employer. Personal risk factors such as diabetes mellitus, hypertension, and obesity may also affect work performance contributing to both absenteeism and presenteeism. Other chronic illnesses such as asthma and cancer also affect work performance. Productivity costs associated with poor employee health have been found to be associated with 2 to 3 times the direct health costs⁴ and unhealthy lifestyles have been shown to be associated with poor health and excess medical expenditures.⁴⁻⁶ Furthermore, modifiable health risks account for 20 to 30% of employee health care costs.^{4,7} As employers typically pay the majority of their workers' health costs⁴ and decreased worker productivity affects the bottom-line, the employer has a vested interest in participating in risk factor modification and in influencing the prevention or control of chronic disease. Worksite health promotion programs have been seen as part of the solution.

The question then arises: how helpful and cost-effective are these programs? Various literature reviews have been conducted on these programs but there are limitations to these reviews including variability in study designs, program evaluation metrics, as well as components and other aspects of the programs themselves^{8,9} As such, comparability is fraught with challenges. Evidence suggests, however, that multi-component worksite programs have been effective in achieving long-term behavior change, the most effective programs offering individualized risk reduction counseling to the highest risk employees within a healthy company culture.⁸ This is logical as risk reduction in the highest risk employees will likely translate into the most obvious incremental change in outcomes as compared to employees with lower risk. Employees with lower risk profiles will likely produce smaller incremental change with less dramatic outcomes. This should not mean, however, that lower risk employees should not also be targeted, as any risk reduction, however incremental, translates into health benefit to the individual, and in aggregate.

Tools have been designed for use in identifying and scoring employers' best practices. These "worksite health index" tools are offered by the Health Enhancement Research Organization (HERO) Scorecard,¹⁰ the National Business Group on Health (NBGH) Wellness Scorecard,¹¹ NIOSH Essential Elements,¹² and the CDC HeartStroke Check¹³ among others. The hope is that they will help define the key elements needed for successful health promotion program implementation.⁸ The Centers for Disease Control and Prevention's Healthy People initiative¹⁴ proposes that comprehensive worksite health promotion program should contain all of the following elements:

- Health education that focuses on skill development and lifestyle behavior change.
- Supportive social and physical environments and policies that promote health.
- Integration of the worksite program into the organization's culture.
- Related programs such as employee assistance programs.
- Screening programs preferably linked to medical care delivery to ensure follow-up and appropriate treatment.

Despite the gains made over the last two decades in the implementation of worksite health promotion initiatives, the degree to which they have been successful is still not clear due in part to limited data and the less-than-optimal data available to evaluate these programs. Many employers have programs in effect, but the results are not being shared in the public domain, e.g., not published. Furthermore, many of the studies have threats to their validity such as lack of a concurrent control group and at times, results conflict.¹⁵ High-quality cluster randomized trials are required. More cohort studies are also needed to assist with comparisons between employers^{15,16} to provide better quality evidence indicating the effectiveness (or not) of these interventions in workplaces. The availability of higher quality data may encourage more companies to implement worksite health promotion programs, potentially including assessment of health risks with feedback.¹⁷ Based on increasing evidence of worksite health promotion program efficacy, combined with modifiable risks and increasing health care costs, initiatives may be more likely to become the norm, helping to not only improve worker health and productivity, but also to improve the nations' overall quality of health.

PRE-PLACEMENT AND PERIODIC EXAMINATIONS

The pre-placement/post-offer medical examination also may aid in reducing the risk for development of WRMSDs occupational asthma and many other health conditions. The physician must be clear about the purpose of the examination and its components. An ideally performed preplacement examination carefully incorporates specific information including the prospective job requirements and exposures, the future employee's prior and current

capabilities, medical and other history and risks anticipated on that specific job. (This information is often gathered by many different professionals, including occupational therapists, physical therapists, industrial hygienists, psychologists, ergonomists, and human factors and safety professionals, as well as physicians who gather data, perform work-site job analyses in order to determine the essential functions/demands of the job, and assist in the design and implementation of pre-placement and periodic examinations based upon job analyses.)

The examination should be designed by defining the type and level of risk to the worker and to others. In general, these examinations are most productive as selection screening in relation to the demands (time, load, repetitions), consequences of error, and person-job fit in areas of high injury with high job demands. The purpose of preplacement examinations should be narrowly job-related; their primary intention should not be to discover hidden diseases and treat them. Preplacement examinations may be used to establish a baseline, especially in workers who have sustained previous injuries or illnesses. It should be noted that these examinations are not regarded as establishing a doctor-patient relationship.

The best situation arises when the physician incorporates knowledge of the requirements of that job. More commonly, the physician may not have viewed that particular job and a job description is available that includes quantified physical demands of the job, especially its essential functions. Quantified or statistics-based scales that rate or list physical demands, emotional demands, hours, working conditions, special equipment and tools used, faculties needed, and vocational qualifications may form the basis for evaluation of job requirements. A combination of descriptions by supervisors, site visits, and a group process used by teams of workers to define actual tasks (the Santa Barbara protocol), videotapes of the job as typically done, or structured questionnaires provides the necessary information for creating the most accurate job descriptions. Job descriptions have increasing limitations due in part to the widespread implementation of job enlargement, which has helped to make quality job descriptions rare, difficult and sometimes impossible. Nevertheless, the maximum weights lifted, or other maximum exposures are often quite helpful.

In evaluating the ability of a worker to do the job as described, the history is very important. If the candidate has had trouble with a similar job or demand in the past, this is a sensitive indicator for further discussions of whether the worker feels they are capable of performing the job, discussions with the supervisor concerning the accuracy of the job description, potential additional job evaluation(s) and/or accommodation.

Tests utilized for evaluating working populations and determining capabilities to successfully perform jobs must have sufficient sensitivity and specificity. Functional capacity evaluations are most often utilized to attempt to address these concerns. Unfortunately, to date they have not been found to accurately predict future workplace injuries or illnesses. They may still help assess if the person can perform the job task on a one-time basis.

If a more comprehensive preplacement examination is done for health promotion or protection purposes, it may identify other risk factors and conditions such as obesity, thyroid disease, poor muscular conditioning, pregnancy, diabetes mellitus, and certain congenital anomalies. The employee should be counseled about factors associated with WRMSDs, risk of occupational pulmonary disorders or other work-related health concerns that are prominent in the proposed job, particularly if he or she has any preexisting medical conditions or known risk factors. This process also allows the health care provider to communicate to the employer the need for appropriate restrictions, accommodations, or task redesign that may permit the employee to work safely.

PHYSICAL HAZARD CONTROL

If it is likely that physical work factors may contribute to subjective or objective health effects, the occupational health provider and the employer should consider methods of hazard control to mitigate the observed effects and improve productivity. Systematic job-task analysis will identify ergonomic and physical risk factors associated with various tasks. This identification should then lead to the implementation of appropriate control measures to reduce employee exposure to these risks when feasible. The following methods of physical and ergonomic hazard control are listed in order of preference:

Engineering Controls. Engineering controls reduce exposure levels and are the preferred method of preventing the development of work-related musculoskeletal health effects. Engineering controls focus on job tasks or

processes. They may include substitution of a chemical to a less toxic compound. Direct engineering changes in job operations may also be made to minimize exposure of workers – for example, use of light curtains, barriers, or enclosed processes. To prevent job-related health effects due to job physical demands, the preferred means may be the development of special tools, jigs, or balances or the adjustment of workstations to reduce high force requirements. Engineering changes are best able to alter levels of necessary force, duration of exertion, high amplitude vibration, noise, temperature, and exposures to chemical and physical hazards. The implementation of proper engineering controls may not preclude the need for administrative controls, employee training, or personal protective equipment, however. The implementation of engineering controls to reduce exposure levels is also the preferred method of controlling the development of work-related nonspecific eye complaints. However, personal protective equipment is often more practical (see below).

Administrative Controls. Administrative controls focus on the worker’s capabilities and motivations and how the job task is done. These controls include job rotation, task separation, elimination of production incentives, reduction of overtime, optimal assignment of shift work, and the provision of appropriate break times. The implementation of such controls can reduce overall job physical exposures, improve recovery time, and reduce the exposure to stressors. Administrative controls also may be considered to improve work-organization tasks that affect the psychological state of the employee. Psychosocial factors that have been associated with work-related complaints include job dissatisfaction, low enjoyment of tasks, poor relationships with supervisors or coworkers, excessive workload, low workload/monotony, ambiguity over career development, lack of employee control, social isolation, deskilling due to a single repeated job task, and simply individual differences leading to poor person-job fit. In some instances, psychosocial stressors have been found to be as important (or more important) in contributing to work-related disorders than physical stressors.

Personal Protective Equipment. If engineering controls of physical, chemical, or biologic hazards are not feasible, appropriate and effective personal protective equipment (PPE) should be used. Hearing protection, impervious gloves, boots, respirators, and eye and face protectors are well-known examples of PPE. However, there are no forms of PPE that well-designed studies have proven effective in preventing WRMSDs.

Work Practice Controls. Work practice controls address the importance of work procedures and practices utilized by the worker. These controls include work techniques, maintenance of tools and equipment, physical conditioning of new or returning workers, optimal lifting and carrying techniques – not always “lift with the knees and not with the back” (see Low Back Disorders chapter) – and best use of equipment and workstations.

MANAGEMENT EDUCATION

Education and information should be provided at all levels of a company. Upper management must understand the risk for WRMSDs, eye, hearing, and respiratory complaints and other health problems in the workforce; the financial and social cost associated with them; and the need for management’s support of line supervisors to implement risk factor controls. Further training may be needed for environmental safety and health staff, plant engineers, human resources personnel, ergonomic teams, and the individual employees themselves. The Occupational Safety and Health Administration (OSHA) [29 CFR 1910.132] requires training on the workplace hazards and use of specific PPE to prevent injury for each of the tasks being performed.

EMPLOYEE EDUCATION AND INVOLVEMENT

Employees should have baseline knowledge of the risk factors for work-related complaints they are most likely to encounter, how to prevent them, and how to access medical care if a health concern develops. Employees also should understand their job responsibilities, job requirements, and duty to comply with health and safety standards developed by both regulatory agencies and the employer. Employees should be encouraged to participate with management in identifying work factors associated with health concerns, and in suggesting methods to control exposure to them. Active participation may facilitate secondary and tertiary as well as primary prevention.

In making realistic recommendations, occupational health providers must balance the cost of preventive efforts (in time, effort, and money) against the expected benefit of designing broad-based or targeted programs. For

example, some primary preventive efforts such as back education or fitness programs are often applied to all workers. However, back pain, while the most common disorder seen in occupational medicine, affects less than 2% of most workforces yearly to a sufficient degree to necessitate treatment, and about 10% of those workers account for more than 80 percent of the costs. In addition, because of the state of knowledge and individual variation in susceptibility and presence of non-work-related risk factors, broad-based prevention efforts for some types of initial or recurrent health concerns may not be cost-effective. Effective targeting of preventive efforts may be difficult as well. A focus on secondarily preventing disability, which often leads to high-cost cases, may prove to be more cost-effective.

Secondary Prevention

Secondary prevention consists of detection and surveillance programs designed to identify early indicators of potential injury or illness (e.g., symptoms, minor injuries, sprains, strains), as well as intervention in an effort to avoid re-injury and/or the worsening of conditions including iatrogenic and advocagenic disabilities. (While prevention interventions are classically categorized into primary, secondary, and tertiary, they should not be considered mutually exclusive when implementing prevention programs.) Secondary prevention is aimed at reducing disability and hastening recovery once a health concern has become apparent. This is a more targeted approach in that it may be apparent which workers are more likely to develop symptoms, illnesses, or injuries. Since secondary prevention involves working in partnership with the worker, the cornerstones of this process are two-way communication, addressing myths and misconceptions, management of expectations, bilateral or trilateral planning, and management of the episode and the situation (see Initial Approaches to Treatment chapter).

Providing modified or temporary duty is important in returning workers to the job and prevents social isolation and deconditioning (see Cornerstones of Disability Prevention and Management chapter). Reconditioning and avoidance of static postures may be important in musculoskeletal disorders both to hasten functional recovery and to prevent recurrences. Back schools are an example of an approach that combines these two areas with imparting information and group support (see Low Back Disorders chapter). Any problems with workstation or task design that contributed to the original problem should be corrected to avoid aggravating the condition.

SURVEILLANCE

Occupational health professionals may work with employers to develop and implement a surveillance system for the detection of work-related health complaints that may cause discomfort, develop into fixed pathology, or impair productivity. The components of an occupational surveillance program are the detection and enumeration of job-related morbidity and mortality, characterization of trends and identification of new patterns or clusters of disease, and monitoring of interventions to decrease frequency or severity of occupational injury or illness. Health surveillance may identify a pattern of development of musculoskeletal, ocular, or other symptoms or of adverse health effects associated with some tasks that could not be predicted through task analysis. This is especially true when development of these conditions is associated with psychosocial more than physical factors. Surveillance may be active or passive. Passive health surveillance may include retrospective review of OSHA logs, absenteeism records, or documents from workers' compensation insurers. Active health surveillance may include questionnaires or routine medical examinations or both. Well-designed medical surveillance which includes the ability to track and trend findings over time may allow the employer to focus resources on those tasks that appear to be most predictive of developing musculoskeletal or other adverse health effects.

Surveillance systems work best when the target disease or disorder has all of the following features:

- Relatively infrequent disorders, rather than highly prevalent diseases.
- Few if any non-occupational risk factors.
- Non-occupational risk factors are not present or rare in the workforce.
- High degree of specificity, with robust linkage between the occupational exposure and the disorder.
- Screening tests have high sensitivity and high specificity.
- Screening tests are not overly invasive or costly.
- Early treatment of a disorder caught by screening or surveillance results in superior outcomes.

A challenge in performing surveillance or screening is the very high prevalence of common MSDs regardless of job physical demands. This makes screening and reporting of early symptoms highly problematic and may suggest a threshold of symptom persistence or disorder severity is necessary before a surveillance system could potentially be somewhat more effective. Nevertheless, early reporting of symptoms is believed to be helpful.

Tertiary Prevention

Tertiary prevention in the work setting involves prevention of recurrences in a patient who has had a previous episode. Tertiary prevention includes vocational rehabilitation and functional restoration in a worker who has had a major alteration in work capacity or life whether due to a major biologic event (e.g., catastrophic injury, severe disease) or a constellation of factors (e.g., iatrogenic disability). The first action is usually to evaluate the job or tasks and the person-job fit and then to modify the job, tasks, or workstation as necessary (see Work Design). Excessive loads, repetition, unusual posture, and other job physical factors should be addressed. If the individual cannot do the job as originally designed because of an impairment, reasonable accommodation may be attempted if it can be provided by the employer. If this is not possible, job placement elsewhere or retraining may be necessary.

SUMMARY

Effective workplace preventive strategies require multilevel engagement and shared responsibility of all stakeholders. Senior management is primarily responsible for fostering the health and safety culture through leadership, supportive corporate policies and the provision of necessary resources, but individual employees should be committed to healthy behaviors and lifestyles. Equally important is the need to connect employees, families and communities. Where applicable, the importance of union leadership is an important factor.

The provision of a safe, clean work environment is the basic building block of primary prevention in the workplace and this is best achieved through the input and monitoring performed by a team of appropriately trained occupational safety and health professionals. For personal risk modification, education is a key element and all levels of management should understand the link between employee health and productivity. Employees likewise need to understand the total costs and value of personal health and the subsequent impact of poor health on business and career success.

Establishing goals and measuring program effectiveness are essential to the success of workplace preventive strategies. These goals may include reduction in injury rates or near misses, participation rates in preventive medicine programs, or targeted outcomes such as stress reduction. Health and productivity metrics, cost, corporate culture, utilization of preventive benefits offered under the employer's health plan, rates of absence and disability are among the many metrics that can be tracked and trended over time to ensure continued progress toward a safe and healthy workplace.

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